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Introduction to Iowa School-Based Oral Health Programs

The purpose of the I-Smile @ School School-Based Oral Health Program Manual is to provide all school-based dental sealant programs (SBSPs) with standardized information consistent with recent research and science and to clearly state program expectations and standards.

Dental sealants are effective in preventing decay and are particularly beneficial for children from low-income families who may not have access to regular dental care. A sealant is a tooth-colored material that is applied to the pit-and-fissure surface of posterior teeth. Sealants provide a physical barrier that prevents food debris and decay-causing bacteria from collecting in the pits and fissures of vulnerable teeth. Applying dental sealants within schools is an effective way to assure that children at greatest risk for tooth decay in newly erupting permanent molars have access to this low-cost, beneficial prevention.

The Iowa Department of Public Health (IDPH) provides grant funding to Title V Maternal and Child & Adolescent Health (MCAH) agencies to administer SBSPs. All SBSPs provide services in schools with higher rates of free and reduced price lunch program participants, ensuring they are reaching the most at-risk children that may not otherwise have access to sealants.

All SBSPs must comply with the requirements detailed in this manual. While Maternal and Child & Adolescent Health and School-based Sealant Program Request for Proposals (RFPs) lay out the expectations of agencies receiving grant funds, this manual has been created to supplement those expectations and to aid all Title V agencies in achievement of their SBSP goals.

This manual reflects professional recommendations based on systematic reviews of the literature by expert panels convened by the Centers for Disease Control and Prevention (CDC) and the American Dental Association (ADA). In addition, it incorporates information compiled by the Best Practices Committee of the Association of State and Territorial Dental Directors.

As part of its accountability to funders, IDPH maintains responsibility for assuring the success and positive impact of the SBSPs. This includes providing guidance and technical assistance to grantees and evaluating the performance of each program and the overall statewide effort.

IDPH provides assistance to help SBSPs improve performance, achieve program goals and meet standards. Technical assistance may be conducted via telephone, email, meetings or site visits as appropriate. IDPH may convene on-site or online meetings to provide program information, and require participation of specific local SBSP staff for these events.
Iowa Department of Public Health Policy Compliance

All School-based Sealant Programs (SBSPs) are components of Title V Maternal and Child & Adolescent Health (MCAH) programs; therefore, the policies and regulations for MCAH are applicable to SBSPs.

SBSPs must:
- ensure services and staffing are consistent and appropriate as they pertain to the approved MCAH plan and contract on file with IDPH and in accordance with federal legislation;
- adhere to the policies addressed in the Iowa Title V Administrative Manual for Community-based Programs;
- adhere to applicable Department of Human Services policies and Iowa Administrative Code (IAC 441); and
- adhere to the IAC 641 rules for IDPH, including chapters 50 and 76.

School-based dental sealant program services (screenings, sealants, fluoride varnish) are within the direct services level of the MCAH pyramid. Programs that include use of an I-Smile™ Coordinator to provide these direct services must ensure that the I-Smile™ Coordinator will continue to meet the minimum requirements for enabling services and public health services and systems, as outlined in the applicable IDPH MCAH Contract.
Iowa Dental Board

The Iowa Dental Board (IDB) is the state agency charged with the overall responsibility for regulating the professions of dentistry, dental hygiene and dental assisting in Iowa. All dental sealant programs in Iowa must use appropriate dental professionals, working within their scope of practice, as identified in the IDB administrative rules.

Iowa Dental Board information can be found at: https://www.legis.iowa.gov/law/administrativeRules/chapters?pubDate=12-11-2013&agency=650.
The Occupational Safety and Health Act of 1970 was passed to prevent workers from being killed or seriously harmed at work. The law requires employers to provide their employees with working conditions that are free of known dangers. The act created the Occupational Safety and Health Administration (OSHA) that sets and enforces protective workplace safety and health standards. OSHA also provides information, training and assistance to workers and employers. OSHA regulations are found at www.osha.gov.

Each Maternal and Child Health agency is responsible for assuring their operation is in compliance with all applicable OSHA requirements. Questions regarding requirements or implementation of OSHA regulations should be directed to the Iowa Labor Services Division at www.iowaworkforce.org/labor/.

The OSHA Bloodborne Pathogens Standard specifies safeguards to protect oral health care workers against the health hazards of bloodborne pathogens. The standard provides the following requirements for the oral health workforce:

- A written exposure control plan must be reviewed and updated annually to include common and potential health hazards.
- Infection control training is required prior to employees working in an environment where exposure to blood or other potentially infectious materials may occur, and on an annual basis thereafter.
- Personal protective equipment (eye protection, gloves and protective clothing) must be worn by all dental personnel.
- Appropriate hand washing must be performed.
- Instruments that can withstand heat must be sterilized in an autoclave. If the instruments cannot withstand heat, a high-level disinfectant must be used according to manufacturer’s directions.
- Disposable items must not be re-used.
- Proper handling and disposal of sharps is required.
- The autoclave must be monitored weekly by biologic spore testing to ensure proper functioning.
- Environmental surfaces must be cleaned and disinfected. Barrier techniques must be used for items that are difficult to clean or disinfect.
- Food/drink is not permitted in clinic areas.

Infection Control

IDPH requires all SBSPs to comply with all infection control guidelines and standards. This would include OSHA and IDB regulations and Centers for Disease Control and Prevention (CDC) recommendations.

The portable nature of SBSPs presents particular challenges for infection control (e.g., safe transport of sharps). This section, which will help SBSPs meet IDPH expectations, is consistent with guidance developed by the Organization for Safety, Asepsis and Prevention (OSAP). OSAP provides an Infection Control Checklist for portable dental settings. This can be used by SBSPs to assess their infection control policies and procedures and is located in the Resources section of this handbook.

The CDC has identified levels of risk for transmission of infections and bloodborne diseases during dental services. These risk levels are based on the anticipated contact between the provider and patients’ mucous membranes and/or blood and blood-contaminated saliva (see Table 1).

<table>
<thead>
<tr>
<th>Level</th>
<th>Anticipated contact with mucous membranes?</th>
<th>Anticipated contact with blood or saliva contaminated with blood?</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>Yes</td>
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<tr>
<td>II</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>III</td>
<td>No</td>
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</tr>
</tbody>
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Sealant programs have two basic procedures: screening for tooth selection and sealant application. Each of these procedures pose a Level II risk, due to provider contact with patients’ mucous membranes and saliva (but no anticipated contact with blood or saliva contaminated with blood). The CDC has four basic principles for infection control: 1.) take action to stay healthy, 2.) avoid contact with blood and other potentially infectious body substances, 3.) make instruments and equipment safe, and 4.) limit the spread of blood and other potentially infectious body substances. The following narrative is based on the four basic principles and a Level II risk.
Principle I: Take Action to Stay Healthy

Immunizations
Program staff immunizations should be current according to CDC’s recommended adult immunization schedule. CDC’s recommended adult immunization is available at: https://www.cdc.gov/vaccines/schedules/downloads/adult/adult-combined-schedule.pdf. New staff should be tested for tuberculosis infection. Documentation of staff members’ hepatitis B vaccination/immunity statuses must be kept on file.

Hand Hygiene
Appropriate hand washing must be performed. Although ideal to be in a room with a sink, this often is not possible. SBSP staff should select the best available site close to a sink. Soap and water, as well as alcohol-based hand sanitizers, may be used for cleansing hands. Hands must be cleansed before and after treating each patient, before donning or after removing gloves, after ungloved contact with surfaces or objects that may be contaminated by blood or other potentially infectious materials, before leaving the operatory, and when hands are visibly soiled. Soap and water (not hand sanitizers) must be used when hands are visibly soiled.

Staff should be trained in the procedures for hand washing and for the use of hand sanitizers. These procedures are as follows:

- Wash hands by vigorously rubbing soap and water over hands and fingers for 15 seconds before rinsing with cool water and thoroughly drying.
- If hand sanitizer is used, apply it to hands and rub hands together as if washing hands until hands are dry.
- Because hand sanitizers do not remove the powdery residue that can form under gloves, program staff using hand sanitizers should also wash hands periodically with soap and water.

Additional hand hygiene information is available at: http://www.cdc.gov/oralhealth/InfectionControl/faq/hand.htm

Principle II: Avoid Contact with Blood and Other Potentially Infectious Body Substances

Personal Protective Equipment
Personal protective equipment (PPE) should be stored close to the patient care area and facilities should be available for disinfection of PPE (e.g., patient eyewear, utility gloves). PPE should be worn in the patient care area only.

Gloves
Gloves are single-use, disposable items, and they cannot be re-used or washed. Gloves that are damaged (e.g., torn, punctured) must be discarded. If gloves are damaged during a procedure, remove and discard them, wash hands immediately, and put on clean gloves.
Over-gloving (e.g., putting a clean pair of gloves over a used pair) between patients is not permitted. Gloves should be removed carefully to avoid exposure to microorganisms from patients. Wearing gloves does not replace hand washing.

Programs must use non-latex gloves, due to possible latex sensitivity among patients and staff. This sensitivity could result in allergic reactions that range from skin rash to anaphylaxis.

Heavy-duty puncture-resistant gloves, along with protective clothing and face protection, must be worn during clean-up and preparation of instruments for sterilization. Utility gloves may be decontaminated and used again, but damaged or worn-out gloves should be discarded.

**Face Protection**
During sealant application, oral health professionals must wear face protection. Face protection includes a chin-length face shield or a surgical mask and eyewear with solid side shields. Masks should be changed between patients or during treatment if they become damp or visibly contaminated. Program staff should remove masks by the fasteners because the front of the mask is considered contaminated and should not be touched. Masks should not be worn off the face or around the neck.

Eyewear and face shields must be cleaned and disinfected between patients, at the end of the day, and if visibly soiled.

**Protective Clothing**
Protective clothing must be worn during sealant application and for screenings where spatter is anticipated due to use of the air/water syringe. Protective clothing must be washed, or, if disposable, discarded.

Protective clothing should be removed immediately, or as soon as possible, if blood or other infectious materials have penetrated it. Protective clothing does not need to be changed after each patient unless it is visibly soiled.

Program staff does not need fluid-resistant gowns unless contact with body fluid that would seep through a garment is anticipated.

**Avoid Injuries**
Program staff must receive education and training at least once per year regarding infection control principles and rationale for recommended infection control practices. In addition, training must be provided upon initial employment or when a change in duties or procedures may affect exposure. Staff designated for specific task responsibilities (e.g., instrument sterilization, waste disposal) should receive appropriate training for that task. Training should address the portable environment and OSHA regulations.
Safe Handling of Sharps
For SBSPs, sharps are generally limited to explorers. All sharps, sterile and contaminated, should be transported in securely closed containers that are puncture-resistant to sharps.

All contaminated disposable sharps must be discarded in a closeable, leak-proof container that is manufactured for that purpose and that is impervious to sharps. The container must be red or labeled with the biohazard symbol, or both. The container must also be labeled “sharps.” The sharps container should be placed in a secure location as close to the user as possible. Program staff should receive training on the proper handling of sharps and their disposal.

Non-disposable contaminated sharps (e.g. explorers) must also be stored in a closable, leak-proof container that is impervious to sharps. This container must be clearly labeled as containing contaminated sharps. Containers with contaminated instruments also should have a biohazard symbol.

Written Policy with Post-Exposure Control Plan
Programs must have a written infection control plan (including a post-exposure control plan) that describes protocols and procedures. The plan should be maintained by a program staff member designated as the infection-control coordinator. In the event that post-exposure care is needed, the program should have access to a health professional qualified to provide post-exposure care, counseling and follow-up. The infection control plan and procedures must be reviewed and evaluated at least annually by program staff and updated as necessary.

Infection Control: Management and Follow-up of Occupational Exposure is available in Appendix 1.

Principle III: Make Instruments and Equipment Safe

Instruments and Equipment
Between each patient, IDPH requires heat sterilization of all reusable patient-care items that touch mucous membranes and can withstand repeated exposure to high heat. Instruments may be heat sterilized on- or off-site. Disposable instruments are a good alternative to reusable instruments.

Programs that use handpieces or air/water syringes that are detachable from the unit must heat sterilize them between patients and follow the manufacturer’s instructions for sterilization and care. If the handpiece or air/water syringe is permanently attached to the unit, programs should barrier protect the handle and either use disposable tips or sterilize metal tips between patients.

IDPH recommends single-use, disposable syringes for programs that use syringes to apply etchants and sealants. Multi-use syringes used in the sealant application process can easily become contaminated. Because these cannot be disinfected or heat-sterilized, the barrel of the
syringe should be covered with a replaceable barrier. Programs that use this item must use a new disposable syringe tip for each patient.

**Instrument Cleaning and Sterilization**

Programs are not required to clean instruments immediately after use; however, soaking instruments immediately after use in detergent, disinfectant/detergent, or enzymatic cleaner in a puncture-resistant container prevents patient matter from drying and makes cleaning easier. If instruments are to be transported off-site, they should be removed from the solution and transported in a securely closed, appropriately labeled, and puncture-proof container. It is recommended that containers storing instruments or sharps for transportation off-site be placed in an additional container, as an additional precaution against spillage of instruments.

Instruments should be cleaned (manually and/or with an ultrasonic cleaner) before being placed in bags or pouches for sterilization. Bags or pouches should be sealed prior to sterilization. A chemical indicator should be placed in the middle of each bag or pouch. If the indicator is not visible through the bag or pouch material, an additional indicator should be placed on the outside. If the indicator does not change color, this may indicate there was a problem during sterilization. Bags or pouches should be clearly labeled with the date, to ensure that the first instruments sterilized will be the first instruments used.

The instrument processing area should be divided into two separate zones: 1.) a “dirty” zone for intake, cleaning, and packaging of contaminated items, and 2.) a “clean” zone for sterilizing instruments, removing packaged items from the sterilizer, cooling them, and storing them. Personal protective equipment and utility gloves should be worn when handling and cleaning contaminated instruments.

After appropriate sterilization, a bag or pouch is considered sterile unless it is compromised (e.g., torn, wet, dropped on floor). If a bag or pouch is compromised, the instruments should be cleaned, placed in a new bag or pouch, and sterilized again. Store packaged instruments in clearly and appropriately labeled puncture-proof and secured containers.

**Off-site sterilization**

Proper instrument transport is critical for off-site sterilization. Sealant programs should use securely fastened containers for transporting instruments so that instruments will not spill when jostled. Cleaning instruments before transport is not required, but it can reduce possible exposure risk during transport.

**On-site Sterilization**

Adequate space for and design of the instrument-processing area is of primary importance for on-site sterilization. The sterilization area should have adequate ventilation, access to a sink, and be near the treatment area. It should have enough space to separate the dirty and clean zones and to allow for receiving, cleaning, packaging, sterilization/disinfection, and storing of processed instruments. Avoid carrying or scrubbing contaminated instruments at times when the area is crowded with children.
Sterilization Monitoring
The autoclave must be monitored every seven days, on the same day each week, by biologic testing (spore test) for proper functioning. Programs must document testing and keep a log with test results. Testing must be done weekly, even if a program operates only one day per week. If a spore test result is positive, IDPH requires that immediate action be taken to ensure that heat sterilization is accomplished. While programs may do biological spore testing themselves, most SBSPs choose to use independent sterilization-monitoring services.

If the autoclave has been idle for an extended period (e.g., during summer break), staff should perform a biologic spore test before program start-up to ascertain whether the autoclave is functioning correctly.

Portable Dental Unit Water Quality
CDC recommends that water used for routine dental treatment meets Environmental Protection Agency (EPA) regulatory standards for drinking water (e.g., <500 CFU/mL of heterotrophic water bacteria). Some manufacturers of portable dental equipment advise that tap water of good quality from a municipal supply or distilled or purified water be used in the water-supply bottle. Programs should consult with the manufacturer of their dental units for appropriate methods and equipment to maintain and monitor dental-unit water quality.

Dental water line cleaners should be used according to the manufacturer’s directions and in accordance with the dental unit manufacturer’s recommendations. Some manufacturers also recommend draining the water at the end of each day.

CDC recommends that water and air be flushed for a minimum of 20–30 seconds after each patient from any device connected to the dental water system that enters the patient’s mouth (e.g., air/water syringe). This is to expel organisms that may have been drawn into the waterline.

Principle IV: Limit the Spread of Blood and Other Infectious Body Substances

Spatter
Use the air/water syringe carefully to avoid creating backsplash or spatter. The high-velocity evacuation (HVE) tubing and container should also be used in such a way as to limit potential spatter. Patients must not close lips around the HVE tip to prevent potential “suck-back” of bacteria that may be in the tubing.

Barriers and Disinfection of Surfaces
Clinical-contact surfaces (e.g., tabletops, instrument tray, light handles) must be covered with barriers or cleaned and disinfected between patients. Barriers must be discarded and replaced between patients. If a surface is not barrier-protected or if contact is made under a barrier, the surface must be cleaned and disinfected with a hospital-grade disinfectant product that is registered with the EPA.
Use the following procedures to clean and disinfect clinical contact surfaces:

1. Spray surface with disinfectant.
2. Wipe surface to clean it, and remove any debris.
3. Spray surface with disinfectant again.
4. Follow manufacturer’s directions for the amount of contact time required to allow the product to achieve disinfection. Then wipe surface clean.

If disinfectant wipes are used, clean the surface and discard the wipe; then use a fresh wipe for disinfection. Follow the manufacturer’s directions.

The HVE tubing and container should be disinfected. Refer to the manufacturer’s instructions for proper disinfection. The entire system should be cleaned and disinfected by evacuating a cleaner/disinfectant through the entire hose assembly and waste bottle each time it is emptied. Thorough scrubbing of the entire assembly is also recommended each time the bottle is emptied.

Programs should have a protocol for the management, storage and disposal of chemical disinfectants. Products must be used appropriately for their intended purpose and with minimum exposure to the sealant team and patients. Areas where chemicals are used should be well-ventilated. Storage should prevent spills or contain them, in the event a spill occurs. Products should not be exposed to high temperatures. Refer to the manufacturer’s instructions for proper handling, storage and disposal of products.

Waste Disposal
Disposal of regulated medical waste (e.g., sharps, blood-soaked gauze) must comply with OSHA rules. Sharps containers should never be emptied. When the contents reach the fill/full line, dispose of the entire container and begin using a new one.

In the unlikely event that a program generates regulated medical waste (e.g., blood-soaked gauze), that waste must be contained in a leak-resistant, securely fastened bag/container. The container should be red or conspicuously labeled with the international biohazard symbol. SBSPs are typically small generators of infectious waste (less than 50 lbs. per month, with proper documentation of infectious waste’s weight available for each month). This allows for the disposal of both non-regulated waste (e.g., gloves, masks, disposable instruments, cotton rolls, protective coverings) and regulated waste (infectious waste) in regular trash bags without special handling. It is best to consult with school personnel about their preferences before discarding non-regulated waste on-site.

CDC guidelines related to waste removal may be found at: http://www.cdc.gov/OralHealth/infectioncontrol/guidelines/index.htm.

Infection Control Practices for School-Based Dental Sealant Programs are summarized in Appendix 2.
Site Assessment
Assessment of the site prior to the date for providing dental services can help prevent concerns with set-up and infection control. OSAP’s Site Assessment Checklist can be found in Appendix 3. It is a useful checklist for confirming that a site meets program needs (e.g., space, utilities) for providing adequate infection control for screenings and sealant application.
Staffing/Personnel Requirements

The School-based Dental Sealant Program (SBSP) has the following staffing / personnel requirements:

- All dental providers – dentists, dental hygienists, and dental assistants – who provide services must be currently licensed or registered with the Iowa Dental Board (IDB).
- Lay people (unlicensed, unregistered, non-dental providers) may not be used in conjunction with any intra-oral, extra-oral, or infection control services.
- Sealant programs must use dentists to provide examinations or dental hygienists to provide screenings to determine which teeth will benefit from the application of dental sealants. Dental hygienists providing screenings must have a public health supervision agreement that allows the hygienist to provide dental screenings to make such a determination in a school setting.
- Programs must use dentists or dental hygienists to apply dental sealants. Dental hygienists applying sealants must have a public health supervision agreement that allows the hygienist to do so in a school setting.
- If applying fluoride varnish, the applicant must use dentists or dental hygienists. Dental hygienists applying fluoride varnish must have a public health supervision agreement that allows the hygienist to do so in a school setting.
- Programs are strongly encouraged to use registered dental assistants to assist dentists and/or dental hygienists to apply dental sealants. Four-handed sealant application may improve the quality and efficiency of sealant placement through shortened placement time, improved isolation, reduction in operator fatigue and enhanced patient care.
- All dental assistants must have a signed public health supervision agreement with a dentist on file at the Iowa Dental Board and the Iowa Department of Public Health (IDPH).

For more information on public health supervision of dental hygienists and assistants, go to: https://www.legis.iowa.gov/docs/ACO/agency/650.pdf
School, Grade, and Tooth Selection

School Selection
SBSPs target schools with a higher proportion of children at risk for tooth decay and lack of access to dental care. Guidelines for selection of schools include the following criteria:

- Forty percent or more of the student body is eligible for Free/Reduced Lunch (FRL) Program.
- Community is identified as high need based on Community Needs Assessment.
- Community has a high percentage of immigrant, migrant worker, refugee, and/or other vulnerable and underserved populations.
- The school is not receiving dental sealant services through another agency or organization.

IDPH sealant grant funds may only be used to provide services in schools in which 40 percent or more of the students are enrolled in FRL programs. Schools with less than 40 percent FRL rates may be served if they meet other guidelines for school selection; however, other sources of funding must be used.

Grade Selection
SBSPs are required to serve second and third graders to seal the first permanent molars shortly after eruption. If program funding and staffing allows, first graders may be targeted to seal permanent first molars that have erupted early; fourth and fifth graders may be targeted to seal permanent first molars that were not sealed previously; and sixth through eighth graders may also be targeted to seal second permanent molars and premolars (if indicated).

If SBSP direct services (screenings, sealants and fluoride varnish) will not be provided to second and third graders, education must be provided to those students.

Tooth Selection
Only sound, noncavitated pit and fissure surfaces of posterior teeth may be sealed. Permanent first and second molars should be sealed shortly after eruption. Premolar (bicuspoid) teeth and deciduous molars may be sealed as needed based on an individual risk assessment.
Equipment

Programs are required to use appropriate equipment, supplies, and techniques to apply dental sealants.

Appropriate equipment includes:

- portable dental unit
- patient chair
- provider stool
- assistant stool (if applicable)
- curing light
- overhead halogen light.

These products are widely available from a variety of vendors. Individual programs may select equipment to meet their program needs. Programs should consider cost-effectiveness and the ability to have the equipment quickly repaired when making selections.

Sealant program equipment should be serviced and maintained according to manufacturer’s directions.
Sealant Materials

IDPH does not require the use of specific brands or types of sealant materials. Sealants should quickly self-adjust through normal occlusion; therefore, programs are encouraged to use resin-based sealant materials with a higher ratio of resin to filler material. Glass ionomer cements should be used when concerns about moisture control are present.

When choosing sealant materials for your program, consider: cost-effectiveness, prolonged retention properties, and simplicity of application. Seal America: The Prevention Invention (https://www.mchoralhealth.org/seal/step-4-5.php) provides a useful overview of the attributes of sealant materials that are appropriate for use in school-based programs.

Etching tooth surfaces prior to sealant placement is an essential step. According to the American Dental Association, a separate etching step (not combined with a bonding agent) may result in higher retention rates.

Hydrophilic bonding agents are not required and are considered a supplemental technique. If used, bonding agents should not be combined with etchant and must be compatible with the sealant material used. There is limited evidence that sealant retention can be improved if a bonding agent containing both an adhesive and a primer is used between the previously etched tooth surface and the sealant material.

IDPH has included a Dental Sealant Product List in Appendix 4.
Application of Sealants

All SBSPs must use techniques that assure dry tooth surfaces at critical points during the sealant application procedure. *Seal America: The Prevention Invention* ([https://www.mchoralhealth.org/seal/step-8-3.php](https://www.mchoralhealth.org/seal/step-8-3.php)) describes the steps in sealant application technique. Each agency must have a written protocol in place describing sealant application procedures.

The following sealant application protocol is from *Seal America* and is recommended by IDPH. Sealant application technique will vary depending upon the type of material and isolation used. Before dental sealants are applied, be sure to read the manufacturer’s instructions carefully, as different brands of sealants may require slightly different application techniques. The basic procedure for applying sealants is as follows:

- **Step 1. Thoroughly clean teeth to be sealed**
- **Step 2. Isolate the teeth**
- **Step 3. Etch tooth surface**
- **Step 4. Rinse and dry**
- **Step 4a. Apply bonding agent**
- **Step 5. Place sealants**
- **Step 6. Polymerize sealants**
- **Step 7. Inspect sealants**
- **Step 8. Remove unpolymerized BPA from sealant**

**Step 1. Thoroughly Clean Teeth to Be Sealed**

Sealant programs may use a dry toothbrush or a handpiece with a bristle brush to clean teeth to be sealed. The teeth must be thoroughly rinsed before they are isolated. *A Comparison of the Effects of Toothbrushing and Handpiece Phrophylaxis on Retention of Sealants*, The Journal of the American Dental Association (JADA) 2009, Gray, S.K. et al, shows that retention of sealants after a supervised toothbrush cleaning was at least as high as those associated with a traditional handpiece. This translates to decreased costs for materials, equipment and personnel. **Products containing fluoride should not be used prior to sealant placement to minimize probability of sealant failure.**

**Step 2. Isolate the Teeth**

Effective saliva control can be achieved by positioning the student so that the teeth to be sealed are visible and accessible. The student’s head can be tilted so that saliva pools on the opposite side of the mouth from the side with teeth being sealed. A high-volume evacuator may be used. Cotton rolls or cotton roll holders and dry angles should be used and positioned as desired. Dry angles are most effective if placed over the parotid duct opening. Consider placing a dry angle between the cotton roll holder and the lingual surface of the mandibular teeth to create an additional barrier for the tongue. Once the cotton rolls are in place, the teeth should be thoroughly dried. Evaluate the student’s ability to tolerate sealant application before attempting to seal multiple teeth at a time.
Step 3. Etch Tooth Surface
The cleaned and dried tooth surfaces are etched with phosphoric acid for at least 20 seconds. A small cotton pellet, mini-sponge, or brush can be used to apply the etchant. Etchants are available in liquid and gel form – the type used is a matter of personal preference. Acid should be placed widely over the enamel surface so there is no chance that the sealant margin is placed on un-etched enamel. If the acid inadvertently comes in contact with soft tissue, it needs to be rinsed immediately and thoroughly.

Step 4. Rinse and Dry
After 20 seconds, thoroughly rinse the etchant off the teeth. It is critical that saliva not come into contact with the prepared tooth surfaces during this step. Excess moisture is removed with a high-volume evacuator. Sometimes dry cotton rolls or dry angles may be placed over the moist ones to maintain a dry field. When dry, a properly etched surface will have a dull matte or frosty appearance, in contrast to the glossy appearance of un-etched enamel. Should salivary contamination occur after this point, the surface must be washed, dried, re-etched for 10 seconds, and washed and dried again before the next sealant-application step.

Step 4a. Bonding Agents
If bonding agents are used, this step needs to be added in the sealant placement process. Once the tooth surface has been etched and thoroughly dried, the bonding agent should be placed on the tooth, and the agent should be air thinned before the sealant is applied. This step helps the sealant material flow into the deep fissures, helps bonding in areas of inadvertent moisture contamination, and improves sealant retention.

Step 5. Place Dental Sealants
Since the application step will vary according to the product selected, and the dentist or dental hygienist should follow the manufacturer’s instructions. The student’s head should be positioned so that the occlusal plane is parallel to the floor to prevent the sealant from flowing distally, leaving the mesial pits underfilled. The dental sealant should be placed into the fissured surface, flowing from one end of the fissure carefully through the fissure complex to avoid air bubbles, and covering only the fissures and a small area of the fissure walls. If more than one tooth in a quadrant is being sealed, the most posterior tooth should be treated first, since maintaining dryness is more difficult in the back of the mouth.

Step 6. Polymerize Dental Sealants
If light-cured sealant material is used, it is important that the curing light is set at the correct intensity and that the manufacturer’s instructions on the length of time the sealant should be exposed to the curing light are followed. With autopolymerized sealants, sufficient time must be allowed so that the depth of the polymerization reaches the tooth surface under the sealant.

Step 7. Inspect Dental Sealants
Isolation of the teeth should be maintained until the dental sealants are checked visually and with an explorer, sealant applicator tip or end of a cotton tip applicator to make sure coverage of the pits or fissures is complete. If there is a surface air bubble, more sealant can be applied if
the tooth has remained uncontaminated. Otherwise, the tooth must be re-etched for 10 seconds, washed, and dried before sealant material is applied. The isolation materials can then be removed, and the student can rinse.

If unfilled or partially filled dental sealant material is used, the students should be told that the sealants may feel “high” but that the student’s own teeth will wear them down during the next few days. If a high-fill sealant material is used, the student’s occlusion may need to be adjusted to remove any “high” spots.

Step 8. Remove Unpolymerized Bisphenol A (BPA) from Dental Sealant
To avoid the unlikely event of BPA toxicity, the surface layer of the dental sealant should be treated to remove unpolymerized BPA remaining on the tooth. This can be done using any one of the following techniques:

1. Wipe the sealant surface using a mild abrasive, such as pumice, either on a cotton applicator or in a prophy cup.
2. Have older students who are able to gargle with tepid water for 30 seconds.
3. Rinse the surface of the sealant for 30 seconds with an air/water syringe, and suction the fluid and debris from the student’s mouth using a four-handed technique.
Additional Recommendations for Sealant Application

The use of a dental assistant is recommended whenever possible. Four-handed sealant application may improve the quality and efficiency of sealant placement through shortened placement time, improved isolation, reduction in operator fatigue and enhanced patient care.

Recommendations from *Techniques for Assessing Tooth Surfaces in School-Based Sealant Programs*, JADA 2010, Fontana, M. et al, have been adapted by IDPH and are expected of all SBSPs. These recommendations are as follows:

- Unaided visual examination is the method of choice when deciding whether a tooth is cavitated and whether a sealant should be placed.
- Dental explorers may be used in SBSPs; however, programs must be aware that noncavitated lesions can become damaged from pressure of the explorer during examination.
- Magnification may be used; however unaided visual assessment of tooth surfaces is the appropriate approach for detection of cavitation in SBSPs.
- Radiographs are not indicated in SBSPs. Radiographic images do not show images of approximal surfaces.
- Caries detection devices and technologies (e.g. DIAGNOdent) are not permitted to be used in SBSPs to determine the need for sealant placement. These devices do not detect lesion cavitation and their misuse could lead to teeth being misclassified and incorrectly precluded from sealant placement.
Retention Checks / Evaluation

Retention checks can be an effective way to evaluate staff performance, identify needed protocol changes, and detect clinical problems related to equipment and/or dental materials. Retention checks are recommended by the National Maternal and Child Oral Health Resource Center’s document, Seal America: The Prevention Invention, and should be performed regularly for quality assurance purposes.

IDPH contractors will be notified of retention check requirements (e.g., the proportion of students checked and the frequency with which they are checked) at the beginning of each contract year.

Short-term Retention Checks
IDPH recommends that a sample of students who receive dental sealants be evaluated a few days or weeks after sealant application to ensure that the dental sealants are intact, adequately cover the occlusal pits and fissures, and have marginal integrity. These short-term retention checks should be completed on as many students as possible. The goal for short-term retention rates of properly applied sealants should be 98-100 percent.

Short-term retention checks can be especially useful in evaluating the performance of a new provider working in the SBSP.

Long-term Retention Checks
Long-term retention checks are done approximately one year following initial sealant placement and are required by IDPH for all contracted programs.

Annual retention checks will occur each year for as many students as possible, or as determined by IDPH. One-year retention rates of sealants should be high, averaging at least 90 percent.
Fluoride Varnish Application

The benefits of fluoride varnish make it extremely useful within public health programs. IDPH recommends that all SBSPs incorporate fluoride varnish applications as part of their preventive services.

Fluoride varnish is highly effective in preventing decay and remineralizing white spot lesions. It is recommended for use on at-risk children as soon as teeth begin to erupt. When applied to teeth, fluoride varnish sets upon contact with saliva. The hardened layer of fluoride is then absorbed into enamel. If not brushed off the teeth, it will continue to be absorbed for several hours. The absorption time is much longer than for traditional fluoride gels and foams. Fluoride varnish application may be applied up to four times a year, based on risk assessment.

Because of the hardening and small amount used, the risk of ingestion and toxicity of fluoride varnish is extremely low, making it safe for young children.

The criteria for application of fluoride varnish include:
- Suspected tooth decay
- White spot lesions
- Visible plaque
- History of decay (fillings or crowns)
- Low socio-economic status

Fluoride varnish application must be provided according to the manufacturers guidelines. The basic application guidelines are:
1. Clean the teeth. Teeth need to be “toothbrush clean” before fluoride varnish is applied.
2. Dry the quadrant to be treated with gauze or air.
3. Apply the varnish to all exposed surfaces of the teeth, including the chewing and interproximal surfaces.
4. Repeat for all remaining quadrants.
5. Provide patient instruction (to parent or patient):
   a. Patient should not brush or floss their teeth for four to six hours following the application.
   b. Patient should wait 2 hours after application before eating crunchy foods or drinking hot drinks.
   c. Patient should be informed that the teeth may appear discolored until the varnish is brushed off.

The IDPH fluoride varnish protocol may be accessed at: http://www.idph.state.ia.us/IDPHChannelsService/file.ashx?file=D3AF5755-9C3F-4442-A390-16DADDFD4366
Care Coordination and Referrals

Each student receiving services through a SBSP must be given a follow-up/referral letter for their parent/guardian which includes services provided, treatment needs, and agency contact information. This letter is further discussed in Section 400.

For those students identified with treatment needs, follow-up care coordination and referrals must be provided. For those students identified without a regular dentist, follow-up care coordination and referrals should be provided.

Care coordination links children and families to needed oral health care services and assures timeliness, appropriateness and completeness of care. Care coordination requires contact with families by face to face, telephone, email or text. Care coordination that is provided via email or text is billable as long as a response is received from the family.

Examples of dental care coordination activities include:

- Assisting clients with locating dentists
- Assisting with scheduling dentist appointments
- Reminding clients that periodic oral screenings or exams are due
- Counseling clients about the importance of keeping appointments
- Providing follow-up to assure that oral health care was received
- Arranging support services such as transportation, child care or translation/interpreter services
- Reinforcing anticipatory guidance
- Linking families to other community services (e.g., WIC)

All SBSPs are required to provide care coordination for those students identified with:
- probable or obvious tooth decay

All SBSPs should attempt to provide care coordination for those students identified with:
- no family dentist according to the student consent form
- a need for assistance to obtain dental or medical insurance
- a parental request for follow-up after sealant application

SBSPs must have protocols in place regarding care coordination and how it will be provided and follow all IDPH requirements for documenting and billing care coordination.
Forms and Reporting

All contracted SBSPs are required to use approved program forms including:

- Combined Consent and Release of Information form
- Sealant Data Recording form
- Parent/Guardian Letter

**Combined Consent and Release of Information form**
For the purposes of a sealant program, a combined consent and release of information may be used. The Iowa Department of Public Health (IDPH) has developed a template for use in sealant programs that contains the minimum information a program must incorporate. Each program has the option of modifying this template for their use; however, if modified, approval from the IDPH Sealant Coordinator must be received prior to use. The Combined Consent and Release of Information form is available in Appendix 5.

**Sealant Data Recording form**
The Sealant Data Recording form captures both screening information and the data indicators needed for the Microsoft Excel data file. A Sealant Data Recording form must be completed for each child examined/screened. IDPH has developed a template for use with this system that contains the minimum information a program must incorporate. Each sealant program has the option of modifying this template for their own use; however, if forms are modified, approval from the IDPH Sealant Coordinator must be received prior to use. The Sealant Data Recording form is available in Appendix 6 and the instructions for completing the Sealant Data Recording form are available in Appendix 7.

**Parent/Guardian Letter**
Every student receiving services through a SBSP must receive a parent/guardian letter to take home that indicates the findings of the screening and treatment needs, if any. Each sealant program has the option of creating its own parent letter, but the one developed for use with this system contains the minimum information a program must incorporate into its own form. If forms are modified, approval from the IDPH Sealant Coordinator must be received prior to use. The Parent Letter form is available in Appendix 8.
Dental Sealant Data Reporting

The Bureau of Oral and Health Delivery Systems within the Iowa Department of Public Health requires specific information about children served through school-based sealant programs to be reported. Data captured, including dental insurance coverage, frequency of dental visits, and untreated decay rates, are used to help assess the oral health status of Iowa children and programmatic needs.

All Title V MCAH agencies providing SBSP services must report their sealant data to IDPH using the TAVConnect Dental Sealant Survey. The dental sealant survey collects all required data and is to be attached to a Sealant Activity if dental sealants were provided to the student. If dental sealants were not provided, the survey must be attached to the Dental Screening Activity to accurately collect all required data.

Information about TAVConnect and system data entry may be found in the TAVConnect Library or provided by the IDPH Sealant Coordinator.

All fields within the Dental Sealant Survey must be completed to ensure data integrity. Agencies will be required to make changes if errors are identified.

IDPH will use Statistical Analysis System (SAS) software to compile the TAVConnect data and provide monthly reports to all programs.

Instructions for completing the Dental Sealant Survey in TAVConnect are included in Appendix 10.
Retention Data

All school-based dental sealant program contractors must submit long-term sealant retention data as prescribed by the Iowa Department of Public Health. At the beginning of each contract year, IDPH will determine if state wide or individual agency retention checks will be required and also the protocols for the retention checks.

If required, contractors will collect sealant retention information on a prescribed number of students that received sealants within their sealant program in the previous year. Long-term retention checks must be completed on teeth that were sealed within the previous 9 to 12 months within the contractor’s school-based sealant program. Each contractor must randomly select and collect information using the School-based Sealant Program Retention Data Form (Appendix 14).

Information to be collected includes:

- **School type**
  - elementary, or
  - middle/junior high school

- **Retention Per Tooth** (permanent first and second molars only)
  - sealant intact,
  - sealant partially retained,
  - sealant not intact, or
  - tooth not sealed in program

All school-based sealant program retention data will be reported to IDPH through the [www.IowaGrants.gov](http://www.IowaGrants.gov) system. IDPH will compile the retention data and disseminate reports and provide technical assistance (if appropriate).
Expense Reporting

Each SBSP contractor must complete and submit a monthly claim report in the Grant Tracking Site located in www.IowaGrants.gov. Claims are due 45 days following the close of each month as stated in the contract.

Only those IowaGrants.gov users that have been assigned to complete the monthly claim report will be able to do so and will receive a system generated notification of the upcoming due date for claims reports.
Client Records

All services provided to students through SBSPs must be entered into the TAVConnect system and in the client paper record or electronic medical record. The client record must detail all services provided, including sealant product used, tooth number and tooth surface.

MCAH contract agencies must assure that employees are allowed access to client records (electronic or paper only) as necessary for the performance of their duties related to the contract and in accordance with policies and procedures.

MCAH client records are the property of the Iowa Department of Public Health. In the event that an MCAH contract is terminated, IDPH will provide direction for the transfer of client records.

All storage, retention and handling of client records must adhere to MCAH policies as found in the Iowa Title V Administrative Manual for Community-Based Programs. You can access this manual here: http://idph.iowa.gov/family-health/child-health.
Sealant Funding

School-based sealant programs (SBSP) are funded through a variety of sources:

- Iowa Department of Public Health (IDPH) SBSP grant funds
- Medicaid billing
- Other funding (community sources, grants)

IDPH SBSP grant funds
Use of grant funds is limited to schools with 40 percent or higher free and reduced lunch rates. Grant funds may be used for personnel and supplies based on limitations within applicable RFPs, RFAs and contracts.

A limited percent of grant funds are allowed to be used for the salaries and fringe or hourly wage of the dental personnel while providing direct services. Refer to the most recent RFP or RFA for details about percentage of grant funding available for direct service costs. Direct service costs only include personnel time spent providing screenings and application of sealant and/or fluoride.

IDPH sealant grant funds are considered payer of last resort and may not be used for services provided to children enrolled in Medicaid

Medicaid billing
Medicaid must be billed for services provided to children enrolled in Medicaid. Prior to billing Medicaid, each agency must have a Medicaid cost plan in place which includes dental sealants. Any Medicaid revenue (or other program income) generated from the sealant program must be used to enhance the sealant program.

Other funding
SBSPs are encouraged to seek funds from community and foundation resources to help expand and sustain their programs. It is the expectation that SBSPs develop a sustainability plan that includes collaboration with community partners and development of program best practices that will allow long-term program sustainability if funding is decreased or not available in the future. Examples of potential funders include: Delta Dental of Iowa Foundation, and service organizations such as Kiwanis and Rotary.

Note: I-Smile™ funds may not be used in the sealant program.
Infection Control: Management and Follow-Up of Occupational Exposure

SBSPs must have an exposure-control plan that delineates post-exposure policies and procedures to follow in case of occupational exposure to blood and other potentially infectious materials. Staff must receive training about these policies and procedures. OSHA has available a sample exposure control plan available at https://www.osha.gov/Publications/osha3186.pdf.

Programs should have access to up-to-date contact information for parents or guardians so that they can quickly obtain informed consent to test a child in case of an occupational exposure. If there is a blood exposure, the exposed person (or the health professional involved, if the exposed person is a patient) should immediately report the exposure to the agency infection-control coordinator. The infection-control coordinator should initiate a referral to appropriate healthcare personnel to provide post-exposure care, counseling, and follow-up and should complete necessary reports about the exposure.

If occupational exposure to a communicable disease occurs, the health professional affected should report the incident to his or her employer. The employer should immediately initiate post-exposure procedures, as appropriate, and should keep a detailed exposure report in the exposed employee’s confidential medical record.

Because multiple factors contribute to the risk of infection after an occupational exposure to blood, the following information should be included in the exposure report, recorded in the exposed person’s confidential medical record and provided to the qualified healthcare professional:

- Date and time of exposure;
- Where, when and how the exposure occurred;
- Identification of the source individual (unless infeasible or prohibited by law);
- Details of the exposure, including its severity and the depth of the wound;
- Details regarding whether the source material was known to contain HIV or other bloodborne pathogens, and, if the source was infected with HIV, the stage of disease, history of antiretroviral therapy, and viral load, if known;
- Details regarding the exposed person (e.g., Hepatitis B vaccination and vaccine response status);
- Details regarding counseling, post-exposure management, and follow-up; and
- Other pertinent information

The confidential medical evaluation must document the circumstances of exposure, identifying and testing the source individual if feasible, testing the exposed employee’s blood (with consent), post-exposure prophylaxis, counseling and evaluation of reported illness. Health care professionals must be provided information to facilitate their evaluation.

The employer will be given a copy of the evaluating health care professional’s written opinion. Findings and diagnoses, other than hepatitis B status, shall be kept confidential and not included in the written report. OSHA requires that employers ensure that employee medical records are kept confidential and not disclosed without the employee’s written consent.


7/2014
## Infection Control Practices for School-Based Dental Sealant Programs

### Principles of Infection Control

<table>
<thead>
<tr>
<th>SEALANT APPLICATION and ASSESSMENT to SELECT TEETH FOR SEALANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level II CONTACT is anticipated (with patient’s mucous membranes and saliva; not with blood or saliva with blood).</td>
</tr>
</tbody>
</table>

1. **Take action to stay healthy**

   **Immunizations**
   - Hepatitis B
   - Vaccine preventable
   - Annual influenza

   **Hand hygiene**
   - Yes

2. **Avoid contact with blood**

   **Personal Protective Equipment (PPE)**
   - Gloves
   - Surgical Masks
   - Protective eyewear or chin-length face shield
   - Long sleeve outer clothing

   **Avoid injuries**
   - Yes

   **Safe Handling of Sharps**
   - Yes

   **Written policy with exposure control plan**
   - Yes

3. **Make patient care items safe for use**

   **Instruments**
   - Sterilization
   - Sterilization Monitoring
   - Portable Dental Unit Water Quality

   **Dispose or heat sterilize**
   - Yes

4. **Limit the spread of blood and other infectious bloody substances**

   **Control contamination**
   - High volume evacuation (HVE)
   - Disinfection/Barriers
   - Waste handling

---

1. If dental provider – Hepatitis B immunity is not required for an individual who is solely recorded for tooth selection, is not subject to spray or splatter from the air/water syringe and has no contact with patients’ mucous membranes and/or with instruments/items that have contact with patients’ mucous membranes.

2. If reusable instruments (e.g., mouth mirrors) are used, these must be cleaned and heat sterilized. If using disposable instruments or disposable tongue blades, place directly in waste container after use.

Infection Control Considerations for Dental Services in Sites Using Portable Equipment or Mobile Vans

Name and Type of Setting: ___________________________________________ Date of assessment: ____________

Range of Proposed Services: ______________________________________________________________________________________

<table>
<thead>
<tr>
<th>Considerations</th>
<th>Acceptable?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>PERSONNEL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site personnel available as point person for fielding questions and concerns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site personnel available for facilitating follow-up of exposures to infectious agents</td>
<td></td>
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<tr>
<td>PHYSICAL</td>
<td></td>
<td></td>
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<tr>
<td>Reasonably accessible route into/within building to transport equipment and supplies</td>
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<tr>
<td>Adequate space for equipment (e.g., chairs, lights, sterilizers)</td>
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<td></td>
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<tr>
<td>Adequate space for supplies</td>
<td></td>
<td></td>
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<tr>
<td>Adequate space for staff movement</td>
<td></td>
<td></td>
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<tr>
<td>Considerations</td>
<td>Acceptable?</td>
<td>Comments</td>
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<td>-------------------------------------------------------------------------------</td>
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<tr>
<td>Adequate space for Patient intake and staging</td>
<td></td>
<td></td>
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<tr>
<td>Adequate space for Radiographic equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate space for Instrument cleaning and processing or secured holding area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate space for safe handling of Medical waste (regulated and non-regulated)</td>
<td></td>
<td></td>
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<tr>
<td>Adequate space for Sharps Disposal</td>
<td></td>
<td></td>
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<tr>
<td>Adequate space for Long and short-term storage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-carpeted areas to provide services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability and close proximity of running water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Close proximity of electrical outlets that accommodate electrical requirements of equipment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Considerations

<table>
<thead>
<tr>
<th>Considerations</th>
<th>Acceptable?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate room lighting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waste disposal requirements for regulated and non-regulated waste known and acceptable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ability to cover or clean and disinfect environmental surfaces in service area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate ventilation for disinfectants, etc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acceptable housekeeping practices for site and treatment area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site restrictions on chemicals, sprays, etc are known and can be accommodated</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## General Assessment of Site:

## Adaptations Needed if Used:
# Dental Sealant Product List

**Major Resin-Based Dental Sealant Products**  
Listed by percent filler

<table>
<thead>
<tr>
<th>Band Name (Manufacturer)</th>
<th>Technique</th>
<th>Filler (% wt.)</th>
<th>Color</th>
<th>Cure Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delton (Dentsply)</td>
<td>Traditional</td>
<td>0%</td>
<td>Clear Tinted White opaque</td>
<td>Auto</td>
</tr>
<tr>
<td>Delton DDS (Dentsply)</td>
<td>Traditional</td>
<td>0%</td>
<td>Clear White opaque</td>
<td>Light</td>
</tr>
<tr>
<td>Helioseal/Helioseal Clear (Ivoclar)</td>
<td>Traditional</td>
<td>0%</td>
<td>Clear White opaque</td>
<td>Light</td>
</tr>
<tr>
<td>Seal America (MPL, Inc.)</td>
<td>Traditional</td>
<td>0%</td>
<td>White opaque</td>
<td>Light Auto</td>
</tr>
<tr>
<td>Clinpro (3M ESPE)</td>
<td>Traditional</td>
<td>6%</td>
<td>Pink when applied → off-white when exposed to curing light</td>
<td>Light</td>
</tr>
<tr>
<td>ClinPro Adper Prompt-L-Pop (3M ESPE)</td>
<td>Self-etch</td>
<td>6%</td>
<td>Pink when applied → off-white when exposed to curing light</td>
<td>Light</td>
</tr>
<tr>
<td>Seal-Rite Low-viscosity (Pulpdent)</td>
<td>Traditional</td>
<td>7.7%</td>
<td>Off-white</td>
<td>Light</td>
</tr>
<tr>
<td>Embrace (Pulpdent)</td>
<td>Hydrophilic (“wet technique”)</td>
<td>34.4%</td>
<td>Off-white natural</td>
<td>Light</td>
</tr>
<tr>
<td>Delton Plus (Dentsply)</td>
<td>Traditional</td>
<td>38%</td>
<td>White opaque</td>
<td>Light</td>
</tr>
<tr>
<td>Delton Seal-N-Glo (Dentsply)</td>
<td>Traditional</td>
<td>38%</td>
<td>Opaque UV-activated dye (blue-white)</td>
<td>Light</td>
</tr>
<tr>
<td>Helioseal F (Ivoclar)</td>
<td>Traditional</td>
<td>41.1%</td>
<td>White opaque</td>
<td>Light</td>
</tr>
</tbody>
</table>

The Iowa Department of Public Health has no financial association with any of the manufacturers listed above. The manufacturers are listed as a service to assist SBSPs in finding appropriate products for their programs. This list is not an endorsement of any company or their products.
**Consent and Release of Information – Template**

<table>
<thead>
<tr>
<th>Child’s Name:</th>
<th>Age:</th>
<th>Date of Birth:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
<td>Cell Phone:</td>
<td>Other Phone:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
<th>Race:</th>
<th>White</th>
<th>Black</th>
<th>Hispanic</th>
<th>Asian/Pacific Islander</th>
<th>Native American</th>
<th>Other</th>
<th>Undetermined / Unknown</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>School:</th>
<th>Teacher’s Name:</th>
<th>Grade:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Child’s Physician:</th>
<th>Child’s Dentist:</th>
</tr>
</thead>
</table>

If applicable, child’s Medicaid ID Number: [ ]

**YES,** I give permission for my child to receive a dental screening, sealants, and fluoride varnish application.

If prophylaxis will be provided, more detailed medical history questions must be added to evaluate a client’s risk for bacterial endocarditis or other conditions.

Please answer the following questions:

1. Is your child currently under a physician’s care? [ ] Yes [ ] No
2. Is your child currently taking any medications? [ ] Yes [ ] No
3. Does your child have any allergies? [ ] Yes [ ] No

Please explain any YES answers: ____________________________

**NO,** I do not give permission for my child to receive a dental screening, sealants, and fluoride varnish application.

1. Does your child have a regular dentist? [ ] Yes [ ] No
2. If yes, does your child see that dentist at least once a year? [ ] Yes [ ] No
3. Is your child eligible for the free/reduced lunch program at school? [ ] Yes [ ] No
4. My child’s most recent dental visit was within the past: (please check one) [ ] 6 months [ ] 12 months [ ] 3 years [ ] 5 years [ ] has never seen a dentist
5. How do you pay for your child’s dental care? (please check one) [ ] Self [ ] Medicaid/Title XIX [ ] hawk-i [ ] Private dental insurance [ ] Other

6. List any concerns you have about your child’s mouth or teeth? ____________________________

I consent to the agency’s use of email and texting to send me scheduling and child health services information.

[ ] Yes [ ] No

- I was offered a Notice of Privacy Practices.
- I understand that this consent is valid for one (1) year unless withdrawn in writing by parent or guardian.
- I understand that the services that will be received do not take the place of regular dental checkups at a dental office.
- I understand that these services are provided under the Iowa Department of Public Health, Maternal and Child & Adolescent Health Program.
- I understand records created and maintained as part of this program are the property of the Iowa Department of Public Health.
- I understand that the information from these records may be shared with the Iowa Department of Public Health, Iowa Medicaid Enterprise, or designee for audit and quality improvement purposes or other legally authorized purposes.

**Parent/Guardian Signature**

[ ]

**Date**

[ ]

I voluntarily authorize (insert your agency name) to release, obtain, or exchange information manually and/or via an electronic platform maintained by TAVHealth with the following: (insert a list of specific possibilities – e.g. physicians, dentists, Head Start). This release does not authorize disclosure of material protected by federal and/or state law applicable to substance abuse, mental health and/or AIDS-related information.

**Parent/Guardian Signature**

[ ]

**Date**

[ ]

Revised 7/2017
## Sample Sealant Data Recording Form

<table>
<thead>
<tr>
<th>ID#</th>
<th>Name</th>
<th>County #</th>
<th>DOB</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sex: M ☐ F ☐</th>
<th>School District</th>
<th>School</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date of Service</th>
<th>Race</th>
<th>Translator Needed?</th>
<th>Medicaid ID #</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>☐ Yes ☐ No</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Has a Dentist?</th>
<th>☐ Yes ☐ No</th>
<th>Free/Reduced Lunch?</th>
<th>☐ Yes ☐ No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Most Recent Visit?</th>
<th>☐ 6m ☐ 12m ☐ 3y ☐ 5y ☐ Never</th>
<th>Payment?</th>
<th>☐ Self ☐ XIX ☐ hawk-i ☐ Ins ☐ Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Oral Screening:

- ☐ Medical history reviewed from consent form
- ☐ D0190CC (initial screening) ☐ D0190 (periodic screening)
- Visible plaque: ☐ none ☐ light ☐ moderate ☐ heavy

### Soft Tissues:

- ☐ no problems ☐ gingivitis: localized___/generalized___
- ☐ trauma ☐ lesions ☐ swelling

Describe: ____________________________________________

### Hard Tissues:

- ☐ no problems ☐ chip ☐ stained pits/fissures
- ☐ decay ☐ demineralized ☐ other_____________________

Describe: __________________________________________

#### D1351 Sealant application: ☐ yes ☐ no

Date: _____ Products used: (ex: 40% Phosphoric Acid Etch Gel & Clinpro Sealant)

#### D1206 Fluoride Varnish application: ☐ yes ☐ no

Product used: (ex: Varnish America 0.25mL)
Fluoride concentration: (ex: 5% NaF2 varnish)

#### Education given: ☐ yes ☐ no

☐ Dietary ☐ Home Care ☐ Fluoride ☐ Other

Notes:

#### D1330 Oral Hygiene Instruction: ☐ yes ☐ no

Time In: _____ Time Out: _____

Notes:

Referral to: ________________________________

Referral: ☐ Immediate ☐ Within ___ months

Follow-up Date: ☐ 3mo ☐ 6mo ☐ 1 year

Parent letter with post-op instructions given for ☐ varnish ☐ sealants

Provider Name/Credentials:

Provider Signature:

---

Rev. 7/2017

Appendix 6
## Recording Key

<table>
<thead>
<tr>
<th>RACE</th>
<th>COUNTY CODE</th>
<th>County</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 White</td>
<td>01</td>
<td>County A</td>
</tr>
<tr>
<td>2 Black</td>
<td>02</td>
<td>County B</td>
</tr>
<tr>
<td>3 Hispanic</td>
<td>03</td>
<td>County C</td>
</tr>
<tr>
<td>4 Asian/Pacific Islander</td>
<td>04</td>
<td>County D</td>
</tr>
<tr>
<td>5 Native American</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Undetermined/Unknown</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### CARIES PREVALENCE

<table>
<thead>
<tr>
<th>Caries Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0  Unerupted / congenitally missing</td>
</tr>
<tr>
<td>1  Sound permanent tooth</td>
</tr>
<tr>
<td>2  Filled permanent tooth</td>
</tr>
<tr>
<td>3  Questionable permanent tooth</td>
</tr>
<tr>
<td>4  Decayed permanent tooth</td>
</tr>
<tr>
<td>5  Crowned permanent tooth</td>
</tr>
<tr>
<td>a  Sound primary tooth</td>
</tr>
<tr>
<td>b  Filled primary tooth</td>
</tr>
<tr>
<td>c  Questionable primary tooth</td>
</tr>
<tr>
<td>d  Decayed primary tooth</td>
</tr>
<tr>
<td>e  Crowned primary tooth</td>
</tr>
<tr>
<td>S  Sealed permanent or primary tooth</td>
</tr>
</tbody>
</table>
Instructions for Completing the Sealant Data Recording Form

The Sealant Data Recording Form serves as the charting for oral screenings and sealant applications. This form also captures the data to be used to complete TAVConnect Dental Sealant Activity and Survey.

A Sealant Data Recording form must be completed for every student seen in the program. The oral screening and individual risk assessment must be completed before any other service is provided. Following the oral screening, use the Caries Prevalence Recording Key on the back of the Sealant Data Recording Form to enter an assessment code for each tooth on the tooth chart.

Once the screening is complete and the assessment data has been recorded, the sealant application may occur. Sealants placed by your program should not be recorded until they are placed.

Fluoride Varnish, education and referrals should be completed after the conclusion of sealant placement. Every student must receive a referral, referral time frame, and a follow-up date. Every Sealant Data Recording Form must be complete with the provider’s name, credentials and signature.

### DEMOGRAPHIC INFORMATION

<table>
<thead>
<tr>
<th>STEP</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Enter the <strong>ID number</strong> for each student examined. This is for the purpose of identifying a student for data clarification only.</td>
</tr>
<tr>
<td>2</td>
<td>Enter the <strong>student’s first and last name</strong>.</td>
</tr>
<tr>
<td>3</td>
<td>Enter the <strong>county number</strong> where the student lives. The Recording Key on the back of the Sealant Data Recording Form identifies county numbers in your service area and contiguous counties.</td>
</tr>
<tr>
<td>4</td>
<td>Enter the student’s <strong>date of birth</strong> (DOB).</td>
</tr>
<tr>
<td>5</td>
<td>Enter the student’s <strong>age</strong>.</td>
</tr>
<tr>
<td>6</td>
<td>Mark “M” if the student is male or “F” if the student is female.</td>
</tr>
<tr>
<td>7</td>
<td>Write in the <strong>school district</strong> name. An abbreviation may be used, but the abbreviation must be defined when submitting the Sealant Data Status Report.</td>
</tr>
</tbody>
</table>
Instructions for Completing the Sealant Data Recording Form

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Write in the <strong>name of the school building</strong>.</td>
</tr>
<tr>
<td>9</td>
<td>Enter the student's <strong>grade number</strong>.</td>
</tr>
<tr>
<td>10</td>
<td>Enter the date of service for the oral screening.</td>
</tr>
<tr>
<td>11</td>
<td>If provided by the parent/guardian, use the Recording Key on the back of the Sealant Data Recording Form to enter the correct number to identify the <strong>race</strong> of the student.</td>
</tr>
<tr>
<td>12</td>
<td>Mark “<strong>yes</strong>” or “<strong>no</strong>” to indicate the need for a <strong>translator</strong> for the student.</td>
</tr>
</tbody>
</table>
| 13 | Enter the student’s **Medicaid ID** number.  
If the student is not enrolled in Medicaid, mark the space N/A. |
| 14 | Mark “**yes**” or “**no**” to match the response on the consent form to “**Does your child have a dentist**?”. |
| 15 | Mark “**yes**” or “**no**” to match the response on the consent form to “Is your child eligible for the **free/reduced lunch** program at school”. |
| 16 | Mark “**6m**”, “**12m**”, “**3y**”, “**5y**”, or “**never**” to match the response on the consent form to “My child’s **most recent dental visit** was within”. |
| 17 | Mark “**self**”, “**XIX**”, “**hawk-i**”, “**ins**”, or “**other**” to match the response on the consent form to “How do you pay for your child’s dental care”. |
Instructions for Completing the Sealant Data Recording Form

**ORAL SCREENING**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mark the box to indicate that the student’s medical history has been reviewed from the consent form.</td>
</tr>
<tr>
<td>2</td>
<td>Mark “D0190CC” that this was an initial screening or “D0190” to indicate that this was a recall screening.</td>
</tr>
<tr>
<td>3</td>
<td>Mark the appropriate response for visible plaque to indicate the student’s plaque level.</td>
</tr>
<tr>
<td>4</td>
<td>Mark the appropriate response(s) to indicate the status of the student’s soft tissues. Provide detail if necessary.</td>
</tr>
<tr>
<td>5</td>
<td>Mark the appropriate response(s) to indicate the status of the student’s hard tissues. Provide detail if necessary.</td>
</tr>
<tr>
<td>6</td>
<td>After completing an I-Smile risk assessment, in the upper right margin, mark one Risk Level (Low, Moderate, High) based on the I-Smile Risk Assessment guidelines. Mark “yes” or “no” to indicate whether or not the student has at least one decayed, filled or sealed tooth.</td>
</tr>
</tbody>
</table>

**CARIES PREVALENCE RECORDING**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>This section applies to ‘Exam’ column on the table on the right side of this form. Following the oral examination or screening, use the Caries Prevalence Recording Key on the back of the Sealant Data Recording Form to enter an assessment code for each tooth. <strong>Each TOOTH will receive one code</strong>, not each surface.</td>
</tr>
</tbody>
</table>
Instructions for Completing the Sealant Data Recording Form

Observe the following hierarchy for teeth that may have more than one assessed criterion:
- sealed teeth have precedence over sound teeth,
- restored teeth have precedence over sealed teeth,
- teeth with untreated decay have precedence over restored teeth.

Note: There is distinctive coding for PRIMARY vs. PERMANENT teeth, so there is no need to differentiate them in any other way.

### SEALANT APPLICATION

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mark “yes” or “no” to indicate D1351 sealant application.</td>
</tr>
<tr>
<td>2</td>
<td>If “yes”, indicate the <strong>products used</strong> for sealant application, including etchant.</td>
</tr>
<tr>
<td>3</td>
<td>Indicate the <strong>date</strong> of sealant placement.</td>
</tr>
<tr>
<td>4</td>
<td>Notes may be made in the space provided if necessary.</td>
</tr>
</tbody>
</table>

### SEALANT RECORDING

This section applies to ‘Seal’ column on the table on the right side of this form.

Following sealant placement, identify any tooth that was sealed in your school-based clinic with an “S” in the Seal column. Only teeth that were sealed should be coded in this column. **DO NOT FILL IN THIS COLUMN UNTIL AFTER THE SEALANT IS PLACED.**

If a tooth was not sealed, there is no documentation required in the ‘Seal’ column on the right side of the form.
Instructions for Completing the Sealant Data Recording Form

**FLUORIDE VARNISH APPLICATION**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mark “yes” or “no” to indicate D1206 fluoride varnish application.</td>
</tr>
<tr>
<td>2</td>
<td>If “yes”, indicate the type of fluoride varnish <strong>product used</strong> and the <strong>fluoride concentration</strong>.</td>
</tr>
<tr>
<td>3</td>
<td>Notes may be made in the space provided if necessary.</td>
</tr>
</tbody>
</table>

**EDUCATION GIVEN**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mark “yes” or “no” to indicate <strong>education</strong> given.</td>
</tr>
<tr>
<td></td>
<td>If “yes”, indicate the type of education provided (dietary, home care, fluoride, or other).</td>
</tr>
<tr>
<td>2</td>
<td>Mark “yes” or “no” to indicate <strong>D1330 Oral Hygiene Instruction</strong> provided.</td>
</tr>
<tr>
<td></td>
<td>If “yes”, record the time in and time out for this service. Documentation of discussion and demonstration in the <strong>Notes</strong>: is also <strong>required for this service</strong>.</td>
</tr>
<tr>
<td></td>
<td>Note: This is a reimbursable service if instruction is provided for a minimum of 8 minutes.</td>
</tr>
</tbody>
</table>

**REFERRAL, FOLLOW-UP AND SIGNATURE**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Indicate the dentist to whom the student was <strong>referred to</strong> following this screening or if the student was provided a dental list.</td>
</tr>
</tbody>
</table>
### Instructions for Completing the Sealant Data Recording Form

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Mark the appropriate response to <strong>Referral</strong> based upon the individual risk assessment.</td>
</tr>
<tr>
<td>3</td>
<td>Indicate the timeframe of the <strong>Follow-up date</strong> by marking the appropriate box.</td>
</tr>
<tr>
<td>4</td>
<td>Mark the appropriate response(s) (varnish, sealants) to indicate <strong>parent letter with post-op instructions given</strong>.</td>
</tr>
<tr>
<td>5</td>
<td>Type, print or stamp the <strong>Provider name/Credentials.</strong></td>
</tr>
<tr>
<td>6</td>
<td>Provide <strong>provider signature.</strong></td>
</tr>
</tbody>
</table>
Your child participated in the dental sealant program at school. As part of the program, your child received a dental screening. No x-rays were taken and the screening does not take the place of a complete dental exam by your family dentist.

The results of the dental screening indicate:

- ☐ Your child has no obvious dental problems but needs to have regular checkups by a dentist.
- ☐ Your child has something that should be checked by a dentist. The dentist will tell you if treatment is needed. Notes:
- ☐ Your child needs immediate care from a dentist. Contact a dentist as soon as possible for a checkup. Notes:

Dental sealants:

- ☐ Were applied today. Sealants were placed on ___ back teeth.
- ☐ Were not applied today due to:
  - ☐ Possible decay. Your child’s teeth should be checked by your family dentist.
  - ☐ Your child already has sealants and/or fillings intact.
  - ☐ Your child’s back teeth that we seal were not fully erupted.
  - ☐ Your child could not tolerate sealant placement today.
  - ☐ Other:

Fluoride varnish:

- ☐ Was applied today. Your child’s teeth may be temporarily discolored. Please have your child avoid crunchy foods today, and please do not brush or floss until tomorrow morning.
- ☐ Was not applied today.

If you have questions about the school dental sealant program, if you do not have a family dentist, or if you have difficulty making a dental appointment, please contact the I-Smile™ coordinator at (phone number).

Revised 7/2015
**Consent Tracking form**

<table>
<thead>
<tr>
<th>School Name: Sample Elementary School</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Targeted Grade</strong></td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td><strong>A.</strong> Students receiving consent forms</td>
</tr>
<tr>
<td>47</td>
</tr>
<tr>
<td><strong>B.</strong> Students returning consent forms</td>
</tr>
<tr>
<td>33</td>
</tr>
<tr>
<td><strong>% CONSENT RETURN</strong></td>
</tr>
<tr>
<td>(B÷A x100)</td>
</tr>
<tr>
<td>70.2%</td>
</tr>
<tr>
<td><strong>C.</strong> Students with positive consent</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td><strong>% POSITIVE CONSENT</strong></td>
</tr>
<tr>
<td>(C÷B x100)</td>
</tr>
<tr>
<td>90.9%</td>
</tr>
</tbody>
</table>
Instructions for Entering Sealant Data into TAVConnect

All contractors must enter sealant data through TAVConnect. Anyone entering sealant data must be registered in TAVConnect with the organization for which the data is being entered.

Use the following instructions to enter required sealant data.

**Sealant Data Entry**

<table>
<thead>
<tr>
<th>STEP</th>
<th>PROCEDURE</th>
</tr>
</thead>
</table>
| 1    | Log into **TAVConnect**.  
  • Search for client using the ‘Search contacts’ function.  
  1. Client record will automatically load or user may choose correct client if multiple clients with the same name appear.  
  2. Create a new client record if one does not already exist in TAVConnect.  
  • Enter the client’s demographic information, including a Client Overview and Oral Health Episode, according to the TAVConnect Oral Health User Manual. |
| 2    | Take ownership of the client if the client is not already in the agency home. |
| 3    | Add an Oral Health Episode if one does not already exist. **The Oral Health Episode must only be added ONCE for the lifetime of the record.**  
  To add an Episode, click on the Universal Add button and select ‘Episode’. |
| 4    | Add an I-Smile @ School Bundle to quickly add the most common dental services provided during an I-Smile @ School program:  
  • Dental – Dental Screening  
  • Dental – Risk Assessment  
  • Dental – Fluoride Varnish  
  • Dental – Oral Hygiene Instruction  
  • Dental – Dental Sealants  
  • Obtain Documentation – Oral Health Consent/ROI  
  • Dental Referral |
**Instructions for Entering Sealant Data into TAVConnect**

To add an Activity Bundle, click on the Universal Add button and select ‘Activity Bundle’.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Enter New Activity Bundle information as prompted:</td>
</tr>
<tr>
<td>5</td>
<td>Episode</td>
</tr>
<tr>
<td></td>
<td>Starting date</td>
</tr>
<tr>
<td></td>
<td>Default Owner</td>
</tr>
<tr>
<td></td>
<td>Bundle</td>
</tr>
</tbody>
</table>

Enter Activity information for all services provided as prompted:

<table>
<thead>
<tr>
<th>6</th>
<th>Date</th>
<th>Will automatically populate based on date of service entered in the New Activity Bundle section.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time In</td>
<td>Report the exact time of day the dental service started. Any dropdown choice can be edited to the exact time. <strong>This field is required for services billed based upon timed units.</strong></td>
</tr>
<tr>
<td></td>
<td>Time Out</td>
<td>Report the exact time of day the dental service ended. Any dropdown choice can be edited to the exact time. <strong>This field is required for services billed based upon timed units.</strong></td>
</tr>
<tr>
<td></td>
<td>Owner</td>
<td>Will automatically populate based on user entered in the New Activity Bundle section.</td>
</tr>
<tr>
<td></td>
<td>Outcome</td>
<td>Report as successful outcome.</td>
</tr>
<tr>
<td></td>
<td>Topics</td>
<td>This is pre-populated but may be changed as needed. This field is used to assist in labeling activities.</td>
</tr>
<tr>
<td></td>
<td>Type of Service</td>
<td>Choose the correct service code and service description.</td>
</tr>
<tr>
<td></td>
<td>ICD-10</td>
<td>Choose the correct ICD-10 diagnosis code and ‘K’ code if</td>
</tr>
</tbody>
</table>
## Instructions for Entering Sealant Data into TAVConnect

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interaction Type</strong></td>
<td>Select the Interaction Type that corresponds with your Dental Service</td>
</tr>
<tr>
<td><strong>County of Service</strong></td>
<td>Select the county where the service is provided from the dropdown box.</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td>Report the specific location of where the service is provided.</td>
</tr>
<tr>
<td><strong>Place of Service</strong></td>
<td>Select the two digit code used as the place of service for billing the CMS 1500.</td>
</tr>
<tr>
<td><strong>Primary Payor</strong></td>
<td>Select the source of payment for this specific service</td>
</tr>
<tr>
<td><strong>Primary Payor No.</strong></td>
<td>Record the number used to bill the service to the primary payor, as applicable.</td>
</tr>
<tr>
<td><strong>Secondary Payor</strong></td>
<td>If known, select the second source of payment that is available to the client but is not paying for this service.</td>
</tr>
<tr>
<td><strong>Secondary Payor No.</strong></td>
<td>If known, record the number used to bill the service to the secondary payor.</td>
</tr>
<tr>
<td><strong>Service Provider</strong></td>
<td>Select the provider of the Health service. (First name, Last name, Credentials)</td>
</tr>
<tr>
<td><strong>Quantity</strong></td>
<td>If documenting dental sealants, record the number of teeth receiving sealants. Otherwise, this field is not applicable.</td>
</tr>
<tr>
<td><strong>Prior Auth No.</strong></td>
<td>Not applicable for this activity.</td>
</tr>
</tbody>
</table>

**Enter your comment**  
**Note:** Comments must be entered after the bundle is saved.

Include any other client specific service notes relevant to providing this service. Clinical documentation is required to support each Dental Service provided. If full clinical documentation is not attached to this service in TAVConnect, use this field to reference the location of supporting documentation.
### Instructions for Entering Sealant Data into TAVConnect

<table>
<thead>
<tr>
<th>Step</th>
<th>Instructions</th>
</tr>
</thead>
</table>
| 4    | (Ex. See client chart for full documentation).  
* If documenting fluoride varnish, indicate the type of fluoride varnish product used and the fluoride concentration in this field.  
* If using Other for the ICD-10 field, enter the corresponding ICD-10 diagnosis code. |
| 7    | Any activity not provided may be deleted by clicking the trash can.  
Once all applicable fields are completed, click ‘Save’ to save the bundle to the client’s record. |
| 8    | The findings of an I-Smile @ School dental screening and sealants placed by the agency are documented in the Dental Sealant Survey. Every client served by the I-Smile @ School program must have a completed Dental Sealant Survey. All fields are expected to be completed, per chart audit requirements.  
To add a Dental Sealant Survey, click the Survey button at the bottom of a dental screening or dental sealant activity. Dental Sealant Surveys may **not** be added via the Universal Add button.  
**NOTE:** If sealants were provided by the agency, the Dental Sealant Survey **MUST** be added to the Dental Sealant Activity. If sealants were not provided by the agency, the Dental Sealant survey should be added to the Dental Screening Activity. |
Instructions for Entering Sealant Data into TAVConnect

Enter Activity information for all services provided as prompted:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td>Report the name of the school building where services are provided.</td>
</tr>
<tr>
<td>School District</td>
<td>Report the name of the school district where services are provided.</td>
</tr>
<tr>
<td>Grade Level</td>
<td>Report the current grade of the student.</td>
</tr>
<tr>
<td>Client has a dentist?</td>
<td>Report whether or not the student has a dentist to match the response on the consent form.</td>
</tr>
<tr>
<td>Most recent dental visit?</td>
<td>Report the most recent dental visit to match the response on the consent form.</td>
</tr>
<tr>
<td>Free / reduced lunch?</td>
<td>Make the appropriate selection to match the response on the consent form.</td>
</tr>
<tr>
<td>Medical history reviewed from consent form?</td>
<td>Mark the response to indicate whether or not the student’s medical history has been reviewed from the consent form.</td>
</tr>
<tr>
<td>Type of screening?</td>
<td>Report the type of screening/exam provided to the client.</td>
</tr>
<tr>
<td>Visible plaque?</td>
<td>Mark the appropriate response to indicate the student’s plaque level.</td>
</tr>
<tr>
<td>Soft tissues</td>
<td>Mark the appropriate response(s) to indicate the status of the student’s soft tissues.</td>
</tr>
<tr>
<td>Describe the soft tissue</td>
<td>Provide details of the student’s soft tissues, if necessary.</td>
</tr>
<tr>
<td>Hard tissues</td>
<td>Mark the appropriate response(s) to indicate the status of the student’s hard tissues.</td>
</tr>
<tr>
<td>Describe hard tissues</td>
<td>Provide details of the student’s hard tissues, if necessary.</td>
</tr>
<tr>
<td>D1351 Sealant application?</td>
<td>Report whether or not sealants were applied.</td>
</tr>
<tr>
<td>Sealant date</td>
<td>Report the date of the sealant placement.</td>
</tr>
<tr>
<td>Sealant product used</td>
<td>Report the sealant product used, including etchant.</td>
</tr>
<tr>
<td>D1206 Fluoride Varnish application?</td>
<td>Report whether or not fluoride varnish was applied. Report fluoride varnish product used and concentration in a Fluoride Varnish activity.</td>
</tr>
<tr>
<td>Fluoride varnish product and concentration used</td>
<td>Report the type of fluoride varnish product used and the fluoride concentration.</td>
</tr>
<tr>
<td>Education given</td>
<td>Report the type of education provided to the student.</td>
</tr>
</tbody>
</table>
## Instructions for Entering Sealant Data into TAVConnect

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education notes</strong></td>
<td>Provide details of the education provided to the student, if necessary.</td>
</tr>
<tr>
<td><strong>D1330 Oral Hygiene instruction?</strong></td>
<td>Mark the appropriate response to indicate whether or not Oral Hygiene Instruction (OHI) was provided to the student.</td>
</tr>
<tr>
<td><strong>Time In</strong></td>
<td>Report the exact time of day the OHI service started. Any dropdown choice can be edited to the exact time. This field is required for services billed based upon timed units.</td>
</tr>
<tr>
<td><strong>Time Out</strong></td>
<td>Report the exact time of day the OHI service ended. Any dropdown choice can be edited to the exact time. This field is required for services billed based upon timed units.</td>
</tr>
<tr>
<td><strong>Parent letter with post-op instructions</strong></td>
<td>Mark the appropriate response(s) to indicate a parent letter with post op instructions was provided to the student.</td>
</tr>
<tr>
<td><strong>Exam Column</strong></td>
<td>The following hierarchy for teeth that may have more than one assessed criterion:</td>
</tr>
<tr>
<td></td>
<td>• Sealed teeth have precedence over sound teeth,</td>
</tr>
<tr>
<td></td>
<td>• Restored teeth have precedence over sealed teeth,</td>
</tr>
<tr>
<td></td>
<td>• Teeth with untreated decay have precedence over restored teeth.</td>
</tr>
<tr>
<td></td>
<td><strong>NOTE:</strong> There is distinctive coding for PRIMARY and PERMANENT teeth, so there is no need to differentiate them any other way.</td>
</tr>
<tr>
<td></td>
<td><strong>Exam Codes:</strong></td>
</tr>
<tr>
<td></td>
<td>0 - Unerupted/congenitally missing permanent tooth</td>
</tr>
<tr>
<td></td>
<td>1 - Sound permanent tooth</td>
</tr>
<tr>
<td></td>
<td>2 - Filled permanent tooth</td>
</tr>
<tr>
<td></td>
<td>3 - Questionable permanent tooth</td>
</tr>
<tr>
<td></td>
<td>4 - Decayed permanent tooth</td>
</tr>
<tr>
<td></td>
<td>5 - Crowned permanent tooth</td>
</tr>
<tr>
<td></td>
<td>a - Sound primary tooth</td>
</tr>
<tr>
<td></td>
<td>b - Filled primary tooth</td>
</tr>
<tr>
<td></td>
<td>c - Questionable primary tooth</td>
</tr>
<tr>
<td></td>
<td>d - Decayed primary tooth</td>
</tr>
<tr>
<td></td>
<td>e - Crowned primary tooth</td>
</tr>
</tbody>
</table>
# Instructions for Entering Sealant Data into TAVConnect

<table>
<thead>
<tr>
<th>Seal Column</th>
<th>S - Sealed permanent primary or permanent tooth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Following sealant placement, identify all teeth that were sealed in your program with an S in the ‘Seal’ box. Only teeth that were sealed in your program should be coded in this column. Do not fill in this column until after the sealant is placed. If a tooth was not sealed, there is no documentation required in the ‘Seal’ box.</td>
</tr>
</tbody>
</table>

10 Click ‘Save’ to save the Dental Sealant Survey.
Appendix 10

Instructions for Entering Sealant Data into TAVConnect

Consent Tracking

All sealant programs must enter Consent Tracking form data **MONTHLY**.

- If there is data to report, follow the instructions below to enter consent tracking data. This data is due on the 15th of the month following services, but data may be entered from the first of the month of services, until submission.

- If there is no data to report, email the Sealant Coordinator to report this.

To enter data:

<table>
<thead>
<tr>
<th>STEP</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Select the agency’s generic Events contact as the client. (In the ‘Search contacts’ function, type ‘events’. Choose the appropriate agency Events contact.) Open the record.</td>
</tr>
<tr>
<td>2</td>
<td>Click on the Universal Add button to add an activity.</td>
</tr>
<tr>
<td>3</td>
<td>Complete the activity as prompted.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Episode</th>
<th>Oral Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Patient Agreement Form</td>
</tr>
<tr>
<td>Owner</td>
<td>Agency Pool</td>
</tr>
<tr>
<td>Date</td>
<td>First day of the month of services provided</td>
</tr>
<tr>
<td>Time</td>
<td>Optional</td>
</tr>
<tr>
<td>Duration</td>
<td>Optional</td>
</tr>
<tr>
<td>Description</td>
<td>Optional</td>
</tr>
<tr>
<td>Outcome</td>
<td>Report successful outcome</td>
</tr>
<tr>
<td>Location</td>
<td>Enter the full name of the school served</td>
</tr>
<tr>
<td>Education Type</td>
<td>Select the targeted grade</td>
</tr>
<tr>
<td>Quantity</td>
<td>Enter the total number of students in the targeted grade receiving consent forms</td>
</tr>
<tr>
<td>Assessment Score</td>
<td>Enter the total number of students in the targeted grade returning consent forms</td>
</tr>
<tr>
<td>Prescribed Number of Visits</td>
<td>Enter the number of students in the targeted grade with positive consent forms</td>
</tr>
<tr>
<td>Enter Your Comment</td>
<td>Optional field</td>
</tr>
</tbody>
</table>
Instructions for Entering Sealant Data into TAVConnect

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Click ‘Save’ to save the Activity.</td>
</tr>
<tr>
<td>5</td>
<td>Repeat the above process for all grades served in each school where I-Smile @ School services are provided.</td>
</tr>
</tbody>
</table>
Instructions for Entering Sealant Data into TAVConnect

**Education Tracking**

All sealant programs must enter Education Tracking form data **MONTHLY**.

- If there is data to report, follow the instructions below to enter education data. This data will be due on the 15th of the month following services, but data may be entered from the first of the month of services, until submission.
- If there is no data to report, email the Sealant Coordinator.

To enter data:

<table>
<thead>
<tr>
<th>STEP</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Select the agency's generic Events contact as the client. (In the ‘Search contacts’ function, type ‘events’. Choose the appropriate agency Events contact.) Open the record.</td>
</tr>
<tr>
<td>2</td>
<td>Click on the Universal Add button to add an activity.</td>
</tr>
<tr>
<td>3</td>
<td>Complete the activity as prompted.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Episode</th>
<th>Oral Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Provide Education</td>
</tr>
<tr>
<td>Owner</td>
<td>Agency Pool</td>
</tr>
<tr>
<td>Date</td>
<td>First day of the month of services provided</td>
</tr>
<tr>
<td>Time</td>
<td>Optional</td>
</tr>
<tr>
<td>Duration</td>
<td>Optional</td>
</tr>
<tr>
<td>Description</td>
<td>Optional</td>
</tr>
<tr>
<td>Outcome</td>
<td>Report successful outcome</td>
</tr>
<tr>
<td>Location</td>
<td>Enter the full name of the school served</td>
</tr>
<tr>
<td>Education Type</td>
<td>Select the targeted grade</td>
</tr>
<tr>
<td>Quantity</td>
<td>Enter the total number of students present for the service</td>
</tr>
<tr>
<td>Enter Your Comment</td>
<td>Optional field</td>
</tr>
</tbody>
</table>

Click ‘Save’ to save the Activity.

| 4    | Repeat the above process for all grades served in each school where I-Smile @ School services are provided. |
## Instructions for Completing the Sealant Retention Data Recording Form

See Section 403.1 for details regarding how to conduct retention checks. Use the instructions below to complete the Sealant Retention Data Recording Form.

<table>
<thead>
<tr>
<th>STEP</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td>Using Appendix 16, determine the random sample of students to be screened.</td>
</tr>
<tr>
<td><strong>2</strong></td>
<td>For each child to be screened, indicate the type of school they were in by marking the appropriate box on the Sealant Retention Data Recording Form (Appendix 14).&lt;br&gt;Mark 1 if: elementary school&lt;br&gt;Mark 2 if: middle/junior high school</td>
</tr>
<tr>
<td><strong>3</strong></td>
<td>The recording form lists student numbers (1, 2, 3…); no additional identification numbers are to be used.</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td>For each student, following the oral examination/screening, use the Retention Per Tooth codes on the Sealant Retention Data Recording Form to enter an assessment code for each molar listed on the form (only first and second permanent molars).&lt;br&gt;The teeth may only be described with an assessment code of 1, 2, 3, or 4. Cells on the recording form may not be left blank.&lt;br&gt;Mark 1 if: the tooth was sealed, and the sealant is still intact and does not need to be replaced.&lt;br&gt;Mark 2 if: the tooth was sealed, and the sealant is partially intact and needs to be replaced.&lt;br&gt;Mark 3 if: the tooth was sealed, and the sealant is not intact and needs to be replaced.&lt;br&gt;Mark 4 if: the tooth was not sealed in the program last year.</td>
</tr>
<tr>
<td><strong>5</strong></td>
<td>Repeat until the prescribed numbers of retention checks (number of students) are completed.</td>
</tr>
</tbody>
</table>
## Instructions for Completing the Sealant Retention Data Recording Form

| 6 | Retain this document until information is entered and submitted via the [www.iowaGrants.gov](http://www.iowaGrants.gov) system. |
**Instructions for Entering Sealant Retention Data into IowaGrants.gov**

Anyone entering sealant data must be registered in IowaGrants.gov with the organization for which the data is being entered. Use the following steps to enter sealant retention data.

<table>
<thead>
<tr>
<th>STEP</th>
<th>PROCEDURE</th>
</tr>
</thead>
</table>
   - Select “My Grants”.  
   - From the “Title” column, select the current Sealant grant name (e.g. Blue County Health Department).  
   - From the “Grant/Project Components” section, select “Progress Reports”. |
| 2    | In the “Type” column, locate “Annual Report”, and then click on the ID number to the left of that. |
| 3    | Click on “Sealant Retention Data Report”. |
| 4    | Click on “Add” at the upper right. |
| 5    | In the “Sealant Retention Data” section, enter information as instructed, following the order of the completed Sealant Retention Data Recording Form. |
| 6    | Click on “Save” at the upper right of the screen. |
| 7    | To add additional students, click on “Add” in the “Category” section. |
| 8    | Once the data for the required number of students to be checked for retention has been entered, click on “Mark as Complete”. |
| 9    | You must then click on “Submit” to complete the submission of the retention data. This must be done prior to the due date. |
## Acronym List

<table>
<thead>
<tr>
<th>ACRONYMS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADA</td>
<td>American Dental Association</td>
</tr>
<tr>
<td>CARes</td>
<td>Child and Adolescent Reporting System</td>
</tr>
<tr>
<td>CDC</td>
<td>Centers for Disease Control and Prevention</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>FRL</td>
<td>Free/Reduced Lunch</td>
</tr>
<tr>
<td>HVE</td>
<td>High-Velocity Evacuation</td>
</tr>
<tr>
<td>IAC</td>
<td>Iowa Administrative Code</td>
</tr>
<tr>
<td>IDB</td>
<td>Iowa Dental Board</td>
</tr>
<tr>
<td>IDPH</td>
<td>Iowa Department of Public Health</td>
</tr>
<tr>
<td>JADA</td>
<td>Journal of the American Dental Association</td>
</tr>
<tr>
<td>MCH</td>
<td>Title V Maternal and Child Health Program</td>
</tr>
<tr>
<td>MOU</td>
<td>Memorandum of Understanding</td>
</tr>
<tr>
<td>MS</td>
<td>Microsoft</td>
</tr>
<tr>
<td>OSAP</td>
<td>Organization for Safety, Asepsis and Prevention</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Act</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
</tr>
<tr>
<td>RFA</td>
<td>Request for Application</td>
</tr>
<tr>
<td>RFP</td>
<td>Request for Proposal</td>
</tr>
<tr>
<td>SBSP</td>
<td>School-Based Sealant Program</td>
</tr>
<tr>
<td>WIC</td>
<td>Special Supplemental Nutrition Program for Women, Infants, and Children</td>
</tr>
</tbody>
</table>
# Sealant Retention Data Recording Form

<table>
<thead>
<tr>
<th>School Type</th>
<th>Retention Per Tooth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 for Elementary</td>
<td>1 sealant intact, does not need replacement</td>
</tr>
<tr>
<td>2 for Middle/Junior High</td>
<td>2 sealant partially retained, needs to be replaced</td>
</tr>
<tr>
<td></td>
<td>3 sealant not intact, needs to be replaced</td>
</tr>
<tr>
<td></td>
<td>4 tooth not sealed in program</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School Type</th>
<th>Student</th>
<th>2</th>
<th>3</th>
<th>14</th>
<th>15</th>
<th>18</th>
<th>19</th>
<th>30</th>
<th>31</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
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<td>9</td>
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<td>10</td>
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<td>11</td>
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<td></td>
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<td>13</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>14</td>
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Random Sampling Instructions

Random sampling helps to accurately determine the retention rate. A random sample gives each student an equal chance to be selected, regardless of their characteristics, such as which school they go to or which provider served them.

Microsoft Excel can be used to generate a random sample, following these steps. **If your sample will include both elementary school students and middle/junior high students, repeat the process for each school type separately.**

1. Based on IDPH guidelines, determine the list of all students eligible for retention checks. This list should broadly represent the students served, though for practical reasons, it may not be from all schools. For example, if your program is not returning to a school this year, you may exclude that school.

2. Put each eligible student ID number in column A of an Excel spreadsheet, in any order (alphabetical, by student number, etc.).

3. In column B, type `=RAND()` into the first cell.

4. Click, hold and drag the first cell to copy it down to every student. This produces a random number for each student.

5. Use the sort option to sort on column B. Use this sorted list to determine your student sample.
Sample Press Release

{Agency/I-Smile @ School logo}

{Date}

PRESS RELEASE – For Immediate Release
Contact: {Name, title, phone number}

I-Smile™ @ School Program
{Community Name} – On {date(s)}, the I-Smile™ @ School program will provide FREE preventive dental services to {number} grade students at {Name of school}. Iowa licensed dentists and dental hygienists will be on-site to provide dental screenings, dental sealants, fluoride varnish, and oral health education during the school day.

Dental sealants are a tooth-colored coating that is painted on the chewing surfaces of the back teeth. Dental sealants protect teeth from germs and food that can cause tooth decay and are quickly applied without pain. Fluoride varnish is a sticky liquid that is applied to strengthen teeth and prevent tooth decay. Fluoride and dental sealants are recommended by the American Dental Association, Centers for Disease Control and Prevention, and the U.S. Surgeon General as important decay prevention measures for assuring optimal oral health.

For additional information on the I-Smile™ @ School program in your area, contact {name and phone number}

###
Evidence-based clinical recommendations for the use of pit-and-fissure sealants
A report of the American Dental Association Council on Scientific Affairs

Jean Beauchamp, DDS; Page W. Caufield, DDS, PhD; James J. Crall, DDS, ScD; Kevin Donly, DDS, MS; Robert Feigal, DDS, PhD; Barbara Gooch, DMD, MPH; Amid Ismail, BDS, MPH, MBA, DrPH; William Kohn, DDS; Mark Siegal, DDS, MPH; Richard Simonsen, DDS, MS

While dental sealants have been recognized as an effective approach to preventing pit-and-fissure caries in children,1,2 clinical questions remain about the indications for placing pit-and-fissure sealants, the criteria for their placement over early caries (that is, noncavitated caries) and techniques to optimize retention and effectiveness. This report on the clinical recommendations for use of pit-and-fissure sealants presents a critical evaluation and summary of relevant scientific evidence to assist clinicians with their clinical decision-making process.

USE OF SEALANTS: AN EVIDENCE-BASED APPROACH

Dentistry is a dynamic profession, continually reshaped by

ABSTRACT

Background. This article presents evidence-based clinical recommendations for use of pit-and-fissure sealants developed by an expert panel convened by the American Dental Association Council on Scientific Affairs. The panel addressed the following clinical questions: Under what circumstances should sealants be placed to prevent caries? Does placing sealants over early (noncavitated) lesions prevent progression of the lesion? Are there conditions that favor the placement of resin-based versus glass ionomer cement sealants in terms of retention or caries prevention? Are there any techniques that could improve sealants’ retention and effectiveness in caries prevention?

Types of Studies Reviewed. Staff of the ADA Division of Science conducted a MEDLINE search to identify systematic reviews and clinical studies published after the identified systematic reviews. At the panel’s request, the ADA Division of Science staff conducted additional searches for clinical studies related to specific topics. The Centers for Disease Control and Prevention also provided unpublished systematic reviews that since have been accepted for publication.

Results. The expert panel developed clinical recommendations for each clinical question. The panel concluded that sealants are effective in caries prevention and that sealants can prevent the progression of early noncavitated carious lesions.

Clinical Implications. These recommendations are presented as a resource to be considered in the clinical decision-making process. As part of the evidence-based approach to care, these clinical recommendations should be integrated with the practitioner’s professional judgment and the patient’s needs and preferences. The evidence indicates that sealants can be used effectively to prevent the initiation and progression of dental caries.

Key Words. Sealant; pit-and-fissure sealant; caries; caries prevention; primary prevention; secondary prevention; evidence-based dentistry; clinical recommendations. JADA 2008;139(3):257-267.
new science, devices, techniques and materials, all of which have increased rapidly since many of today’s practicing dentists were trained. During the past 30 years, evidence-based approaches have developed that involve rigorous summary of findings from clinical studies about the effectiveness of preventive and treatment strategies, with the aim of providing the best available information to clinicians for decision making. In a changing practice environment, it is important that educational institutions and providers of continuing education continually update the state of the evidence related to the effectiveness of sealants in dental caries prevention and management.

Clinical decision making reflects the intersection of science, professional judgment and patients’ desires. Decisions about sealant use should be based on the best available evidence about the effectiveness of the intervention and on knowledge of the epidemiology of dental caries (risk factors and patterns of disease). Therefore, this report includes a section addressing caries prevalence according to tooth surface and population group. This information should help to ensure that sealants are used appropriately within the context of these recommendations.

This report was developed through a critical evaluation of the collective body of published scientific evidence, conducted by an expert panel that was convened by the American Dental Association Council on Scientific Affairs. These clinical recommendations are not a standard of care, but rather a useful tool for dentists to use in making clinically sound decisions about sealant use. These clinical recommendations should be integrated with the practitioner’s professional judgment and the individual patient’s needs and preferences. While these recommendations are applicable to multiple settings, the Centers for Disease Control and Prevention (CDC) is developing recommendations for use of pit-and-fissure sealants specific for school-based programs.

Caries: Definition and Prevention

Definition of dental caries. This report defines caries as the manifestation of the stage of the caries process at any given point in time. The caries process occurs across time as an interaction between biofilm (that is, dental plaque) and the tooth surface and subsurface. The bacteria in biofilm are metabolically active, which causes fluctuations in plaque fluid pH. These fluctuations may cause a loss of mineral from the tooth when the pH level is dropping or a gain of mineral when the pH level is increasing. Progression occurs when the equilibrium between demineralization and remineralization is imbalanced, leading to a net mineral loss. In clinical care settings, diagnosis of caries implies not only determining whether caries is present (that is, detection) but also determining if the disease is arrested or active and, if active, progressing rapidly or slowly.

Caries is an infectious oral disease that can be arrested in its early stages. Caries can be prevented and managed in many ways. Approaches include primary prevention, defined as interventions provided to avert the onset of caries, and secondary prevention, defined as interventions to avert the progression of early caries to cavitation.

Epidemiology. In data from 2004, 42 percent of children and young adults aged 6 to 19 years had dental caries (decayed or filled) in their permanent teeth. Prevalence of dental caries increases with age, ranging from 21 percent among those aged 6 to 11 years to 67 percent among adolescents aged 16 to 19 years. The prevalence of dental caries is higher among children from low-income families and those of Mexican-American ethnicity. Overall, about one-quarter of carious surfaces remain untreated in children and young adults with any caries. About 90 percent of carious lesions are found in the pits and fissures of permanent posterior teeth. These data also indicate that around 40 percent of children aged 2 to 8 years have experienced dental caries (decayed or filled) in their primary teeth. Similar to the findings for the permanent teeth, the prevalence of dental caries and of untreated decay in the primary teeth is higher among children from low-income families and those of Mexican-American ethnicity. Overall, about one-half of carious surfaces remain untreated among children with any caries. About 44 percent of carious lesions in primary teeth are found on the pits and fissures of molars.

The role of pit-and-fissure sealants in primary and secondary prevention. Pit-and-fissure sealants can be used effectively as part of a comprehensive approach to caries prevention on
an individual basis or as a public health measure for at-risk populations. Sealants are placed to prevent caries initiation and to arrest caries progression by providing a physical barrier that inhibits microorganisms and food particles from collecting in pits and fissures. It is generally accepted that the effectiveness of sealants for caries prevention depends on long-term retention.\(^5,11,12\) Full retention of sealants can be evaluated through visual and tactile examinations. In situations in which a sealant has been lost or partially retained, the sealant should be reapplied to ensure effectiveness.

Pit-and-fissure sealants are underused, particularly among those at high risk of experiencing caries; that population includes children in lower-income and certain racial and ethnic groups.\(^13\) The national oral health objectives for dental sealants, as stated in the U.S. Department of Health and Human Services initiative Healthy People 2010, includes increasing the proportion of children who have received dental sealants on their molar teeth to 50 percent.\(^14\) However, national data collected from 1999 through 2002 indicated that sealant prevalence on permanent teeth among children aged 6 to 11 years was 30.5 percent,\(^15\) but this represents a substantial increase over the 8 percent prevalence reported in a survey conducted in 1986 and 1987.\(^16\)

**Types of sealant materials and placement techniques.** Two predominant types of pit-and-fissure sealant materials are available: resin-based sealants and glass ionomer cements. Available resin-based sealant materials can be polymerized by autopolymerization, photopolymerization using visible light or a combination of the two processes.\(^11\)

Glass ionomer cements are available in two forms, both of which contain fluoride: conventional and resin-modified.\(^17\) Glass ionomer cements, which do not require acid etching of the tooth surface, generally are easier to place than are resin-based sealants. They also are not as moisture-sensitive as their resin-based counterparts. Glass ionomer materials, which were developed for their ability to release fluoride, can bond directly with enamel. It is hypothesized that release of fluoride from this material may contribute to caries prevention. However, the clinical effect of fluoride release from glass ionomer cement is not well-established. Clinical studies have provided conflicting evidence as to whether these materials significantly prevent or inhibit caries and affect the growth of caries-associated bacteria compared with materials not containing fluoride.\(^18-20\)

A transient amount of bisphenol-A (BPA) may be detected in the saliva of some patients immediately after initial application of certain sealants as a result of the action of salivary enzymes on bisphenol-dimethacrylate, a component of some sealant materials.\(^21-24\) According to research, systemic BPA has not been detected as a result of the use of such sealants, and potential estrogenicity at such low levels of exposure has not been documented.\(^22\)

Pit-and-fissure sealant materials vary, as do the techniques used to place them. Manufacturers’ instructions for effective placement and long-term retention of resin-based sealants typically include cleaning pits and fissures, appropriately acid etching surfaces and maintaining a dry field uncontaminated by saliva until the sealant is placed and cured. Supplemental techniques and recommendations as cited in the literature may include using bonding agents; using various forms of mechanical enamel preparation, such as air abrasion and modification with a bur (enameloplasty); and using the four-handed application technique.

Bonding agents, also known as adhesives, may be used when applying pit-and-fissure sealants. Current bonding systems are marketed as total- and self-etch systems. The total-etch systems involve a three- or two-step placement technique, with a separate step for acid etching. The self-etch systems are packaged either as self-etching primers with separate adhesives or all-in-one systems that combine acid etchants, primers and adhesives. Both systems are available in single or multiple bottles.\(^25\)

**Clinical questions regarding pit-and-fissure sealants.** Although the scientific evidence supports the use of pit-and-fissure sealants as an effective caries-preventive measure, clinical questions remain about the indications for placing pit-and-fissure sealants, criteria for their placement over early (noncavitated) caries and techniques to optimize retention and caries prevention. To address these topics, the expert panel considered the following clinical questions:

- Under what circumstances should sealants be placed to prevent caries?
- Does placing sealants over early (noncavitated) lesions prevent progression of the lesions?
- Are there conditions that favor the placement...
of resin-based versus glass ionomer cement sealants in terms of retention or caries prevention?

Are there any techniques that could improve sealants’ retention and effectiveness in caries prevention?

These clinical recommendations do not address the cost-effectiveness of using pit-and-fissure sealants. However, multiple models have shown that basing selection criteria for sealant placement on caries risk is cost-effective. Readers are referred to resources cited in the reference list for further discussion of cost-effectiveness.

**METHODS**

In this report, we provide an abbreviated description of the review method we used. The full methods, including the complete search strategy, are provided as Appendix 1 in supplemental data to the online version of this article (visit “http://jada.ada.org”).

The ADA Council on Scientific Affairs convened a panel of experts to evaluate the systematic reviews and clinical trials identified by staff of the ADA Center for Evidence-based Dentistry (CEBD). The council selected panelists on the basis of their expertise in the relevant subject matter. The expert panel convened at a workshop held at the ADA Headquarters in Chicago Nov. 13-15, 2006, to evaluate the collective evidence and develop evidence-based clinical recommendations for use of pit-and-fissure sealants.

CEBD staff members searched MEDLINE to identify systematic reviews that addressed the four clinical questions. They conducted a second search to identify clinical studies published since the identified systematic reviews were conducted.

Members of the expert panel (B.G. and W.K.) presented an unpublished manuscript that examined individual studies included in three recent systematic reviews regarding sealant effectiveness. That manuscript now has been published. CDC completed a multivariate analysis of factors associated with sealant retention, including use of the two-handed method versus the four-handed method. The included studies evaluated the retention of second- or third-generation resin-based sealant materials and provided data on whether the sealant was applied with the two-handed or the four-handed method.

For each identified systematic review and clinical study, the panel determined the final exclusion of publications. They excluded publications on the basis of the following criteria: they did not directly address one of the identified clinical questions; the sealant materials they described were not available in the United States; and the panelists had concerns about the methodology described. Appendix 2 in the supplemental data online is a list of excluded publications.

For each included publication, the panel developed an evidence statement and graded it according to a system modified from that of Shekelle and colleagues (Table 1). The panel developed clinical recommendations that were based on the evidence statements. They classified clinical recommendations according to the strength of the evidence that forms the basis for the recommendation, again using a system modified from that of Shekelle and colleagues (Table 2). It is important to note that while the classification of the recommendation may not directly reflect the importance of the recommendation, it does reflect the quality of scientific evidence that supports the recommendation. Because the effectiveness of sealants depends on clinical retention, the panelists chose to accept clinical sealant retention as a reasonable proxy for caries prevention.

The panel submitted these clinical recommendations to numerous scientific experts and organizations for review. The expert panel scrutinized all comments received and made appropriate revisions in the recommendations. (Appendix 3 in the supplemental data online provides a list of external reviewers.) The final clinical recommendations were approved by the ADA Council on Scientific Affairs.

**PANEL CONCLUSIONS BASED ON THE EVIDENCE**

The following evidence statements and corresponding classification of evidence (in parentheses) represent the conclusions of the expert panel.

- **Evidence regarding sealants for caries prevention.**
  - Placement of resin-based sealants on the permanent molars of children and adolescents is effective for caries reduction (Ia).
  - Reduction of caries incidence in children and adolescents after placement of resin-based sealants ranges from 86 percent at one year to 78.6 percent at two years and 58.6 percent at four years (Ia).
Sealants are effective in reducing occlusal caries incidence in permanent first molars of children, with caries reductions of 76.3 percent at four years, when sealants were reapplied as needed. Caries reduction was 65 percent at nine years from initial treatment, with no reapplication during the last five years (Ib).

Pit-and-fissure sealants are retained on primary molars at a rate of 74.0 to 96.3 percent at one year (II) and 70.6 to 76.5 percent at 2.8 years (II) (III).

There is consistent evidence from private dental insurance and Medicaid databases that placement of sealants on first and second permanent molars in children and adolescents is associated with reductions in the subsequent provision of restorative services (III).

Evidence from Medicaid claims data for children who were continuously enrolled for four years indicates that sealed permanent molars are less likely to receive restorative treatment, that the time between receiving sealants and receiving restorative treatment is greater, and that the restorations were less extensive than those in permanent molars that were unsealed (III).

**Evidence regarding placing sealants over early (noncavitated) lesions.**

Placement of pit-and-fissure sealants significantly reduces the percentage of noncavitated carious lesions that progress in children, adolescents and young adults for as long as five years after sealant placement, compared with unsealed teeth (Ia).

There are no findings that bacteria increase under sealants. When placed over existing caries, sealants lower the number of viable bacteria by at least 100-fold and reduce the number of lesions with any viable bacteria by 50 percent (Ia).

**Evidence regarding sealant materials.**

Results in two of three reviewed studies indicate that resin-based sealants are more effective in caries reduction at 24 to 44 months after placement than is glass ionomer cement in permanent teeth of children and adolescents (Ia).

There is limited and conflicting evidence that glass ionomer cement reduces caries incidence in permanent teeth of children (II), although retention rates of glass ionomer cement are low (Ia).

In a population with a low caries incidence, use of glass ionomer cement is not effective in reducing the incidence of caries when placed in caries-free first primary molars (Ib).

**Evidence regarding sealant placement techniques.**

There is limited and inconclusive evidence in favor of using air abrasion as a cleaning method before acid etching to improve sealant retention (II).

The use of air abrasion instead of acid etching...
reduces the rate of sealant retention\textsuperscript{74,75} (Ib).

\begin{itemize}
\item There is limited and conflicting evidence that mechanical preparation with a bur results in higher retention rates in children\textsuperscript{72,73,77} (Ib).
\item There is indirect evidence that use of the four-handed technique when placing resin-based sealants is associated with improved retention rates\textsuperscript{86} (III).
\end{itemize}

- Sealant retention can be improved if the clinician applies a bonding agent that contains both an adhesive and a primer between the previously acid-etched enamel surface and the sealant material\textsuperscript{67,68} (Ib).
- Presently available self-etching bonding agents, which do not involve a separate etching step, provide comparable or less retention than do bonding agents that involve a separate acid-etching step\textsuperscript{69,70} (Ib).

\section*{Clinical Recommendations}

The expert panel makes the following evidence-based recommendations for each question regarding the placement of pit-and-fissure sealants (Table 3). The strength of each recommendation is assigned on the basis of the level of evidence associated with each recommendation, as described in the Methods section. In instances in which the recommendation is extrapolated from the evidence, the strength of the recommendation is lowered to reflect the extrapolation.

Qualifying notes on the recommendations appear in Box 1. After reviewing the evidence and developing the recommendations, the expert panel identified several areas in which additional research is necessary to answer many questions regarding pit-and-fissure sealants and provide further evidence (Box 2, page 264).

\subsection*{Pit-and-fissure sealant placement for caries prevention.}

- Sealants should be placed on pits and fissures of children’s primary teeth when it is determined that the tooth, or the patient, is at risk of experiencing caries\textsuperscript{10,61} (III, D).\textsuperscript{8,11}
- Sealants should be placed on pits and fissures of children’s and adolescents’ permanent teeth when it is determined that the tooth, or the patient, is at risk of experiencing caries\textsuperscript{2,5,33,46,47,55,66} (Ia, B).\textsuperscript{8,11}
- Sealants should be placed on pits and fissures of adults’ permanent teeth when it is determined that the tooth, or the patient, is at risk of experiencing caries\textsuperscript{2,5,33,46,47,55,66} (Ia, D).\textsuperscript{8,11}

\subsection*{Pit-and-fissure sealant placement over}

\textbf{Box 1}

\textbf{Qualifying notes on clinical recommendations.}

\begin{itemize}
\item Change in caries susceptibility can occur. It is important to consider that the risk of developing dental caries exists on a continuum and changes across time as risk factors change. Therefore, clinicians should re-evaluate each patient’s caries risk status periodically.
\item Clinicians should use recent radiographs, if available, in the decision-making process, but should not obtain radiographs for the sole purpose of placing sealants. Clinicians should consult the American Dental Association/U.S. Food and Drug Administration\textsuperscript{69} guidelines regarding selection criteria for dental radiographs.
\item “Noncavitated carious lesion” refers to pits and fissures in fully erupted teeth that may display discoloration not due to extrinsic staining, developmental opacities or fluorosis. The discoloration may be confined to the size of a pit or fissure or may extend to the cusp inclines surrounding a pit or fissure. The tooth surface should have no evidence of a shadow indicating dentinal caries, and, if radiographs are available, they should be evaluated to determine that neither the occlusal nor proximal surfaces have signs of dentinal caries.
\item These clinical recommendations offer two options for situations in which moisture control, such as with a newly erupted tooth at risk of developing caries, patient compliance or both are a concern. These options include use of a glass ionomer cement material or use of a compatible one-bottle bonding agent, which contains both an adhesive and a primer. Clinicians should use their expertise to determine which technique is most appropriate for an individual patient.
\end{itemize}

early (noncavitated) carious lesions\textsuperscript{4} to prevent progression.

- Pit-and-fissure sealants should be placed on early (noncavitated) carious lesions, as defined in this document, in children, adolescents and young adults to reduce the percentage of lesions that progress\textsuperscript{82} (Ia, B).\textsuperscript{1}
- Pit-and-fissure sealants should be placed on early (noncavitated) carious lesions, as defined in this document, in adults to reduce the percentage of lesions that progress\textsuperscript{82} (Ia, D).\textsuperscript{1}

Conditions that favor the placement of resin-based versus glass ionomer cement.

- Resin-based sealants are the first choice of material for dental sealants\textsuperscript{5,50} (Ia, A).
- Glass ionomer cement may be used as an interim preventive agent when there are indications for placement of a resin-based sealant but concerns about moisture control may compromise such placement\textsuperscript{17,50,51,55,65} (IV, D).\textsuperscript{4}

\subsection*{Placement techniques for pit-and-fissure sealants.}

- A compatible\textsuperscript{5} one-bottle bonding agent, which
The clinical recommendations in this table are a resource for dentists to use in clinical decision making. These clinical recommendations must be balanced with the practitioner’s professional judgment and the individual patient’s needs and preferences.

Dentists are encouraged to employ caries risk assessment strategies to determine whether placement of pit-and-fissure sealants is indicated as a primary preventive measure. The risk of experiencing dental caries exists on a continuum and changes across time as risk factors change. Therefore, caries risk status should be re-evaluated periodically. Manufacturers’ instructions for sealant placement should be consulted, and a dry field should be maintained during placement.

### TOPIC RECOMMENDATION GRADE OF EVIDENCE STRENGTH OF RECOMMENDATION

<table>
<thead>
<tr>
<th>Topic</th>
<th>Recommendation</th>
<th>Grade of Evidence</th>
<th>Strength of Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caries Prevention</td>
<td>Sealants should be placed in pits and fissures of children’s primary teeth when it is determined that the tooth, or the patient, is at risk of developing caries.</td>
<td>III</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>Sealants should be placed on pits and fissures of children’s and adolescents’ permanent teeth when it is determined that the tooth, or the patient, is at risk of developing caries.</td>
<td>Ia</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>Sealants should be placed on pits and fissures of adults’ permanent teeth when it is determined that the tooth, or the patient, is at risk of developing caries.</td>
<td>Ia</td>
<td>D</td>
</tr>
<tr>
<td>Noncavitated Carious Lesions</td>
<td>Pit-and-fissure sealants should be placed on early (noncavitated) carious lesions, as defined in this document, in children, adolescents and young adults to reduce the percentage of lesions that progress.</td>
<td>Ia</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>Pit-and-fissure sealants should be placed on early (noncavitated) carious lesions, as defined in this document, in adults to reduce the percentage of lesions that progress.</td>
<td>Ia</td>
<td>D</td>
</tr>
<tr>
<td>Resin-Based Versus Glass Ionomer Cement</td>
<td>Resin-based sealants are the first choice of material for dental sealants.</td>
<td>Ia</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Glass ionomer cement may be used as an interim preventive agent when there are indications for placement of a resin-based sealant but concerns about moisture control may compromise such placement.</td>
<td>IV</td>
<td>D</td>
</tr>
<tr>
<td>Placement Techniques</td>
<td>A compatible one-bottle bonding agent, which contains both an adhesive and a primer, may be used between the previously acid-etched enamel surface and the sealant material when, in the opinion of the dental professional, the bonding agent would enhance sealant retention in the clinical situation.</td>
<td>Ib</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>Use of available self-etching bonding agents, which do not involve a separate etching step, may provide less retention than the standard acid-etching technique and is not recommended.</td>
<td>Ib</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>Routine mechanical preparation of enamel before acid etching is not recommended.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>When possible, a four-handed technique should be used for placement of resin-based sealants.</td>
<td>III</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>When possible, a four-handed technique should be used for placement of glass ionomer cement sealants.</td>
<td>IV</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>The oral health care professional should monitor and reapply sealants as needed to maximize effectiveness.</td>
<td>IV</td>
<td>D</td>
</tr>
</tbody>
</table>

* Change in caries susceptibility can occur. It is important to consider that the risk of developing dental caries exists on a continuum and changes across time as risk factors change. Therefore, clinicians should re-evaluate each patient’s caries risk status periodically.

† Clinicians should use recent radiographs, if available, in the decision-making process, but should not obtain radiographs for the sole purpose of placing sealants. Clinicians should consult the American Dental Association/U.S. Food and Drug Administration guidelines regarding selection criteria for dental radiographs.

‡ “Noncavitated carious lesion” refers to pits and fissures in fully erupted teeth that may display discoloration not due to extrinsic staining, developmental opacities or fluorosis. The discoloration may be confined to the size of a pit or fissure or may extend to the cusp inclines surrounding a pit or fissure. The tooth surface should have no evidence of a shadow indicating dentinal caries, and, if radiographs are available, they should be evaluated to determine that neither the occlusal nor the proximal surfaces have signs of dentinal caries.

§ These clinical recommendations offer two options for situations in which moisture control, such as with a newly erupted tooth at risk of developing caries, patient compliance or both are a concern. These options include use of a glass ionomer cement material or use of a compatible one-bottle bonding agent, which contains both an adhesive and a primer. Clinicians should use their expertise to determine which technique is most appropriate for an individual patient.

¶ Clinicians should consult with the manufacturer of the adhesive and/or sealant to determine material compatibility.
Research recommendations.

The expert panel identified the following topics as areas for additional research to provide a stronger evidence base for the application of pit-and-fissure sealants for caries prevention. These research topics have not been arranged in order of priority.

**PREVENTIVE EFFECTIVENESS AND COST-EFFECTIVENESS OF VARIOUS PROTOCOLS FOR SELECTION OF PATIENTS AND TEETH FOR SEALANT PLACEMENT**
- Systematic review of evidence from insurance databases regarding the effectiveness and potential cost-effectiveness of sealants in preventing caries
- Clinical trials regarding the sealing of noncavitated and cavitated carious lesions using standardized diagnostic criteria
- Clinical trials regarding the sealing of noncavitated smooth-surface lesions
- Clinical trials regarding placement of sealants in adults
- Clinical trials regarding placement of sealants on surfaces other than the occlusal surfaces of permanent molars, including premolars, buccal and lingual pits of molars and cingula of anterior teeth
- Effectiveness of different management options for noncavitated carious lesions
- Methods to determine arrest of dentinal caries as measure of sealant effectiveness
- Clinical trials regarding minimally invasive techniques to manage early caries (noncavitated) and cavitated carious lesions
- Clinical methods to detect when an early (noncavitated) carious lesion is active or nonactive (that is, arrested)
- Cost-effectiveness of caries-management strategies

**TIMING OF SEALANT APPLICATION**
- Clinical trials using sealants in adults
- Clinical trials using sealants in primary teeth
- The timing of caries initiation and subsequent progression of pit-and-fissure caries in contemporary populations of various caries-risk status

**RESEARCH REGARDING SEALANT MATERIALS AND RETENTION**
- Enamel penetration of the materials used in the sealant application process
- Depth of polymerization of sealant materials as it affects sealant retention
- Additional studies regarding the factors that affect clinical retention and effectiveness of sealants
- Evaluation of the effect of fissure-cleansing methods and materials, including laser use, on clinical outcomes
- Effectiveness of self-etching primers in enhancing clinical sealant retention
- Effectiveness of isolation techniques, including rubber-dam and four-handed technique
- Evaluation of changes in retention associated with new products (such as bonding agents)
- Research and systematic reviews regarding the use of bonding agents to enhance sealant retention
- Effect of one-step adhesives on sealant retention
- Retention of light-cured sealants
- Effect of mechanical preparation on sealant retention

**POINT-OF-CARE APPLICATION OF GUIDELINES**
- Translation of sealant guidelines into clinical practice

contains both an adhesive and a primer, may be used between the previously acid-etched enamel surface and the sealant material when, in the opinion of the dental professional, the bonding agent would enhance sealant retention in the clinical situation. Use of available self-etching bonding agents, which do not involve a separate etching step, may provide less retention than the standard acid-etching technique and is not recommended before acid etching is not recommended.

- When possible, a four-handed technique should be used for placement of resin-based sealants.
- When possible, a four-handed technique should be used for placement of glass ionomer cement sealants.
- The oral health care professional should monitor and reapply sealants as needed to maximize effectiveness.

**CARIRES RISK**

The panel encourages dentists to use caries risk assessment strategies in their practices. Multiple models have showed that basing selection criteria for sealants on the patient’s caries risk is cost-effective. It also is important to consider that the risk of experiencing dental caries exists on a continuum and changes across time as risk factors change. Therefore, a patient’s caries risk status should be re-evaluated periodically. The panel recognizes that there is not a single system of caries risk assessment that has been shown to be valid and reliable. However, dentists can use clinical indicators to classify caries risk status to predict future caries experience. Caries risk assessment should be integrated with the practitioner’s professional expertise to determine treatment...
options. The reader is referred to other resources for further discussion of caries risk.

CLINICAL DETECTION OF NONCAVITATED PIT-AND-FISSURE CARIOUS LESIONS

Visual examination after cleaning and drying the tooth is sufficient to detect early noncavitated lesions in pits and fissures. The clinician should clean the tooth surface to remove debris and plaque before examining it for the presence of white demineralization lines or light yellow-brown discoloration surrounding the pit or fissure area. Noncavitated lesions also may appear as light to dark yellow-brown demineralization in

of early signs of dental caries.

The use of explorers is not necessary for the detection of early lesions, and forceful use of a sharp explorer can damage tooth surfaces. The clinician should use recent radiographs, if available, in the decision-making process but should not obtain radiographs for the sole purpose of placing sealants. The Guide to Patient Selection for Dental Radiographs written by the ADA and the U.S. Food and Drug Administration should be incorporated into the comprehensive care of the patient. There are many technologies that detect caries. Recent reviews suggest that these devices should be used only as adjunc-

Figure 1. Tooth surface with an early (noncavitated) carious lesion that exhibits a white demineralization line around the margin of the pit and fissure and/or a light brown discoloration within the confines of the pit-and-fissure area. Image provided courtesy of Dr. Amid I. Ismail, the Detroit Dental Health Project (National Institute of Dental and Craniofacial Research grant U-54 DE 14261-01).

Figure 2. A small, distinct, dark brown early (noncavitated) carious lesion within the confines of the fissure. Image provided courtesy of Dr. Amid I. Ismail, the Detroit Dental Health Project (National Institute of Dental and Craniofacial Research grant U-54 DE 14261-01).

Figure 3. A deep fissure area (arrow 1) and another area exhibiting a small light brown pit and fissure (arrow 2). Note that the lesion does not extend beyond the confines of the pit and fissure. Image provided courtesy of Dr. Amid I. Ismail, the Detroit Dental Health Project (National Institute of Dental and Craniofacial Research grant U-54 DE 14261-01).

Figure 4. A more distinct early (noncavitated) carious lesion (arrow) that is larger than the normal anatomical size of the fissure area. Image provided courtesy of Dr. Amid I. Ismail, the Detroit Dental Health Project (National Institute of Dental and Craniofacial Research grant U-54 DE 14261-01).

Figure 5. A more distinct early (noncavitated) carious lesion (arrow) that is larger than the normal anatomical size of the fissure area. Image provided courtesy of Dr. Amid I. Ismail, the Detroit Dental Health Project (National Institute of Dental and Craniofacial Research grant U-54 DE 14261-01).
These evidence-based recommendations are a resource to be considered in the clinical decision-making process, which also includes the practitioner’s professional judgment and the patient’s needs and preferences. The recommendations address circumstances in which sealants should be placed to prevent caries, sealant placement over early (noncavitated) lesions, conditions that favor the placement of resin-based versus glass ionomer cement, and techniques to improve sealants’ retention and effectiveness in caries prevention.

**Conclusions**

- Pit-and-fissure sealants can be used effectively as part of a comprehensive approach to caries prevention. While sealants have been used for primary caries prevention, current evidence indicates that sealants also are an effective secondary preventive approach when placed on early noncavitated carious lesions. Caries risk assessment is an important component in the decision-making process, and it is important to re-evaluate a patient’s caries risk status periodically.

**Disclosure:** None of the authors reported any disclosures.

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78. Shekelle PG, Woolf SH, Eccles M, Grimshaw J. Clinical guide-
Techniques for assessing tooth surfaces in school-based sealant programs

Margherita Fontana, DDS, PhD; Domenick T. Zero, DDS, MS; Eugenio D. Beltrán-Aguilar, DMD, MPH, MS, DrPH; Shellie Kolavic Gray, DMD, MPH

Background. The authors reviewed the evidence supporting current guidelines for the detection of cavitated carious lesions. Currently, cavitation is the point at which sealants are not placed in school-based programs.

Types of Studies Reviewed. The authors did not perform a formal systematic review. However, they examined existing systematic reviews of caries detection and diagnosis, including those presented at the 2001 National Institutes of Health Consensus Conference on Management of Caries, published evidence related to the International Caries Detection and Assessment System criteria and other peer-reviewed publications. Where the authors found ambiguity or uncertainty in the evidence, they consulted with fellow members of an expert work group.

Results. Visual examination is appropriate and adequate for caries assessment before placing sealants. The clinician should not use an explorer under force. Radiographs are not indicated solely for the placement of sealants, and the use of magnification and caries detection devices is not necessary to determine cavitation.

Clinical Implications. This report focuses on tooth assessment, in particular the detection of carious lesion cavitation in school-based sealant programs. These recommendations must be balanced with the dentist’s expertise, available treatment options, the patient’s preferences and access to care.

Key Words. Sealants; caries; cavitated lesions; noncavitated lesions; detection; assessment; occlusal surfaces.
When deciding which tooth surfaces to seal, clinicians need to ask one important question: "What methods are used to identify sound surfaces and noncavitated lesions and to discriminate them from cavitated lesions?" To reach an answer, the expert work group sought evidence from systematic reviews, including those presented at the National Institutes of Health Consensus Development Conference on Diagnosis and Management of Dental Caries Throughout Life; from criteria proposed by international groups building on best evidence—that is, the International Consensus Workshop on Caries Clinical Trials and the International Caries Detection and Assessment System (ICDAS); and from studies published after 2001, as identified in MEDLINE searches, such as the work by Bader and colleagues.

The approach to identifying tooth surfaces to be sealed differs between clinical practices and SBSPs. In clinical practice, treatment planning is based on risk factors at the individual tooth or patient level, a range of caries diagnostic and management options are available, and care likely is continuous. In SBSPs, which target high-risk populations, all permanent molars that can be appropriately isolated and assessed as sound or as having noncavitated carious lesions are sealed. In SBSPs, the decision to seal rests almost entirely on visual detection of the presence or absence of surface cavitation. To target the first permanent molars, most programs focus on children in the second and third grades. If resources permit, many programs also target second permanent molars in the sixth grade. According to the State and Territorial Dental Public Health Programs, in 2008, 39 of 51 states and the District of Columbia had sealant programs benefiting almost 355,000 children.

The primary objective of this report was to review the state of the science and underlying rationale of methods used to determine the presence or absence of occlusal surface cavitation (and that of pit and fissure surfaces, such as buccal pits) in molars before sealant placement in school programs. In preparing this report, we did not perform a formal systematic review. However, the evidence reviewed included existing systematic reviews of caries detection and diagnosis (including those presented at the 2001 National Institutes of Health Consensus Development Conference on Management of Dental Caries Throughout Life), published evidence related to the ICDAS criteria and other peer-reviewed publications. Where we found ambiguity or uncertainty in the evidence, we consulted with other members of the expert work group.

Dental professionals can better understand the objectives and context of sealant placement in school programs by knowing the rationale behind tooth-surface assessment and caries-detection methods in SBSPs. This may be especially important when dental professionals speak with parents or see children in their offices who have participated in these programs. In addition, dentists and dental hygienists who participate in SBSPs can use this information to guide their treatment decisions.

### DENTAL CARIES AND CAVITATED VERSUS NONCAVITATED LESIONS

U.S. data indicate that about 90 percent of carious lesions are found in the pits and fissures of permanent teeth, with molars being the most susceptible. Teeth are most susceptible to dental caries during the earlier years after eruption. At the demographic level, the disease is distributed unequally across the population, with certain groups (for example, people of lower socioeconomic status, minorities), such as those targeted by SBSPs, experiencing larger numbers and greater severity of carious lesions.

Dental caries develops in places in which plaque accumulates and remains relatively undisturbed for extended periods in stagnant sites such as pits and fissures of surfaces. Initially, the process remains clinically undetected. At some point, however, the first clinical signs of dental caries appear and can progress across time. Because dental caries follows a dynamic but not necessarily continuous process, carious lesions can be arrested or even reversed—for example, via use of fluorides—before progressing to cavitation. In the case of pit and fissure caries, the process also can be arrested mechanically with dental sealants. The ability to differentiate between the stages of lesion development or to establish the appropriate detection thresholds for these stages depends on the detection method being used, the criteria being used or both.

On the basis of currently available data in the

### ABBREVIATION KEY. ADA: American Dental Association. CDC: Centers for Disease Control and Prevention. ICDAS: International Caries Detection and Assessment System. SBSPs: School-based sealant programs.
literature, clinicians do not need to differentiate lesion staging before cavitation, because cavitation is the point at which sealants no longer should be placed.\textsuperscript{1,4} This is especially the case in SBSPs in which treatment options are limited, thus greatly simplifying the choice of caries detection methods in these settings.

**DIAGNOSIS VERSUS DETECTION**

Sometimes the terms “caries diagnosis” and “caries detection” are incorrectly thought to be equivalent. A clinician diagnoses the disease dental caries in a patient on the basis of a variety of signs and symptoms and detects the consequences of the caries process, which manifest as a carious lesion. Therefore, to diagnose means not only to find the existing carious lesions (that is, detection), but, most importantly, to decide if they are active (that is, disease present), progressing rapidly or slowly, or already arrested. Without this information, a clinician cannot make a logical decision about treatment.\textsuperscript{16,17} Assessing the patient’s risk of developing new carious lesions is associated with diagnosis. Both diagnosis and risk assessment should help the clinician decide on appropriate and effective treatment options\textsuperscript{6,16,18} in particular for carious lesions at earlier stages.

However, as stated previously, in SBSPs the decision to seal rests almost entirely on visual detection of the presence or absence of surface cavitation. Detected cavitated lesions generally are not self-cleaning and, thus, are likely to progress. Therefore, dental professionals usually consider them to be sites of active disease. Consequently, the criteria and methods discussed in this report focus primarily on the ability to detect cavitated lesions as the cutoff point for sealant placement in SBSPs. We do not discuss the ability of methods to diagnose dental caries.

**VALIDITY OF DETECTION METHODS IN RELATIONSHIP TO SCHOOL-BASED SEALANT PROGRAMS**

Ideally, we would like to use a caries detection method that always identifies sound surfaces (that is, a highly specific method) and carious lesions (that is, a highly sensitive method). Identifying sound surfaces as having carious lesions (that is, a false-negative finding) can lead to unnecessary treatment and missing carious lesions (a false-positive finding) can lead to undertreatment. However, none of the currently available caries detection methods have both high sensitivity and high specificity. Therefore, choosing the best approach depends on the particular clinical situation.

For SBSPs, it is important to correctly identify sound and noncavitated lesions, because these are the targets for sealant placement. Because detection methods seek to detect positive outcomes (that is, cavities), SBSPs would benefit from the use of a method that favors false-negative over false-positive results. Thus, a highly specific test is most desirable. The current clinical examination for dental caries involving the use of visual or visual and tactile methods has low sensitivity (that is, it does not allow for correct identification of all existing carious lesions)\textsuperscript{15,20}; the clinical implication of this is that some noncavitated lesions may be missed. Two systematic reviews\textsuperscript{8,21} showed that visual or visual and tactile methods have higher specificity than some commercially available detection methods, such as laser fluorescence or fiber optic transillumination. Thus, visual methods result in fewer false-positive results and are desirable for use in SBSPs.

**ASSESSING PIT AND FISSURE SURFACES FOR CARIOUS LESIONS**

Clinicians have used several methods during the assessment of occlusal surfaces to detect carious lesions, including visual assessment, use of an explorer, air-drying, use of magnification and radiographic examination. We discuss each of these relative to its ability to detect cavitated lesions in SBSPs (Table\textsuperscript{7,21-26}). Of course, for any surface to be assessed with these methods, the tooth must be erupted sufficiently to be considered for sealant placement.\textsuperscript{1,4}

**Visual assessment to detect cavitation.**

The ADA and CDC both support the use of unaided visual examination as the method of choice for deciding whether a tooth is cavitated and whether a sealant should be placed.\textsuperscript{1,4} The array of options available in a traditional clinical setting enables private practitioners to differentiate between cavitated, noncavitated and sound pit and fissure surfaces and allows for targeted prevention or treatment. SPSPs, however, focus on identifying cavitated pit and fissure surfaces to determine whether or not to place a sealant. As stated in a 2001 systematic review,\textsuperscript{20} however, little high-quality evidence exists and a limited number of studies are available to judge the accuracy of methods (including visual, visual and tac-
Investigators have developed many criteria for the visual examination of teeth for carious lesion assessment. A team of international caries researchers and clinicians reviewed the best available evidence regarding caries detection criteria and used it to develop ICDAS, which has some level of histologic validation. These criteria provide scoring that is based on visual assessment and support unaided visual assessment as adequate and appropriate to categorize surface cavitation, signs of dentinal involvement or both.

A noncavitated lesion, commonly referred to as a “white spot lesion,” is a carious lesion whose surface appears macroscopically to be intact (Figure). It may appear as a white, yellow or brown coloration that may be limited to the confines of the pits and fissures. A cavitated lesion, on the other hand, is identified by a discontinuity or break in the surface (Figure). By the time this occurs, demineralization in most cases has progressed histologically, radiographically, clinically or a combination of these into the dentin. The break can be limited to enamel but with signs of undermined enamel (that is, dark coloration around the pit and fissure) or it can expose dentin directly to the oral cavity. The clinician can determine the presence of dentinal involvement, such as an underlying dark shadow, without extensive drying of the tooth surface. However, he or she must clean the tooth surface to remove debris and plaque before examining it. This can be done simply by using a toothbrush and water.

**Explorer use.** Until about the early 1980s, the use of an explorer or a probe to confirm cavitation (catch), especially in pits and fissures, was one of the most common procedures to detect dental caries, and researchers used these instruments widely in early protocols. Up until the 1990s, dental schools taught this technique, despite calls for less invasive use of the explorer. Even though reports in the current literature highly discourage the forceful use of a sharp explorer for the sole purpose of detecting carious lesions, some clinicians continue to use one. The ICDAS does not include the use of a sharp explorer or probe under force for caries detection. The evidence shows clearly that noncavitated lesions can become damaged simply through pressure from the explorer during an examination, which, in turn, introduces a pathway for continued caries progression. Furthermore, limited evidence suggests that use of an explorer does not improve the accuracy of visual assessment in the detection of pit and fissure lesions.

### TABLE

<table>
<thead>
<tr>
<th>RECOMMENDATION</th>
<th>SUMMARY OF EVIDENCE</th>
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<tr>
<td>Unaided visual assessment is appropriate and adequate</td>
<td>Although systematic reviews do not allow definitive confirmation of the accuracy of unaided visual assessment to identify cavitated lesions, the recommendation is based on best available evidence and expert opinion³⁴</td>
</tr>
<tr>
<td>Use of the explorer does not improve the accuracy of visual assessment and can damage the tooth; thus, its use, especially under force, is not recommended</td>
<td>Although systematic reviews do not allow definitive confirmation of the accuracy of explorer use to identify cavitated lesions, the recommendation is based on best available evidence and expert opinion³⁴</td>
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<tr>
<td>Use of magnification cannot be recommended because no data exist to suggest it is necessary, but it is not contraindicated</td>
<td>Limited evidence⁶ from in vitro studies suggests that use of magnification does not increase the ability to identify sound surfaces (that is, it has the same specificity as that of unaided visual examination), while the data regarding its usefulness to help detect carious lesions (that is, sensitivity) are conflicting</td>
</tr>
<tr>
<td>Radiographs are not indicated solely for the placement of sealants</td>
<td>Systematic reviews and other evidence do not allow definitive confirmation of an improvement in accuracy resulting from the addition of radiographs to visual assessment of occlusal surfaces. Existing data suggest that radiographs have low sensitivity and high specificity regarding the detection of early occlusal lesions</td>
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<tr>
<td>Technologically advanced methods are not helpful in the detection of cavitated lesions</td>
<td>Technologically advanced methods have been developed and tested primarily for detection and monitoring of early non-cavitated lesions; systematic reviews conclude that these devices increase the likelihood that sound teeth or those with noncavitated lesions will be classified as carious (owing to low specificity compared with that of visual assessment), and their usefulness to detect cavitated lesions has not been established</td>
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* Source: Ismail and colleagues.⁷  
† Sources: Lussi⁸ and Penning and colleagues.⁹  
‡ Sources: Lussi¹⁰ and Forgie and colleagues.¹¹  
¶ Source: Dove.¹²  
§ Source: Bader and Shugars.¹³
However, clinicians may use an explorer safely in several applications:\(^2\)7:
- to gently remove plaque and debris from the tooth surface;
- to detect changes or breaks in the surface contour by moving it gently, in cases in which there is doubt about the presence of a cavitation;
- to evaluate the smoothness or roughness of the tooth surface to help determine lesion activity;
- to help in the assessment of sealant integrity and retention.

**Magnification.** Magnification may be useful for surface assessment, sealant application and retention checks; however, relatively little research exists regarding its use to assess the caries status of occlusal surfaces of permanent teeth. Among the in vitro studies that do exist, analyses of visual assessment with or without magnification produced conflicting results. In 1993, Lussi\(^24\) compared unaided visual inspection with inspection with a \(\times 2\) magnifying glass, visual inspection with conventional bitewing radiographs, and visual and tactile inspection with gentle probing, as well as analyzed bitewings alone. He found that magnification did not result in significantly improved sensitivity with regard to caries detection. In 2002, Forgie and colleagues\(^25\) reported that use of a \(\times 3.25\) loupe for occlusal and approximal surface assessment resulted in significantly higher sensitivity than that of unaided visual inspection. Specificity, however, was similar to that of unaided visual inspection.

Thus, there is limited evidence in the scientific literature to support the use of magnification with visual assessment of tooth surfaces for sealant placement. In addition, its impact on SBSPs in terms of effectiveness and sealant retention is unknown. Moreover, we have found no evidence that other magnification methods, such as the use of operating microscopes with magnifications of \(\times 16\) or \(\times 24\), add any benefit to the assessment of tooth surfaces, and because of the cost and operational burden, there would be little benefit to SBSPs. Although magnification is not contraindicated, the unaided visual assessment of occlusal surfaces is the appropriate approach for detection of cavitation in SBSPs.

**Radiographs.** Most SBSPs target children with newly erupted permanent molars and typically do not obtain radiographs. The recently published guidelines\(^1\) for SBSPs indicate that a low likelihood of caries in newly erupted teeth, coupled with current recommendations to seal sound surfaces and those with non-cavitated lesions, argue against the use of radiographs. In addition, national surveys conducted since the late 1980s have shown that the most affected surfaces are occlusal, not approximal, with carious lesions starting in the pits and fissures, especially for children in second and third grades.\(^9,42\)

The most recent guidelines developed by the ADA and the U.S. Food and Drug Administration\(^43\) state that “radiographs should be taken only when there is an expectation by dentists that the diagnostic yield will affect patient care.” Radiographic images of approximal surfaces are not necessary to evaluate pit and fissure surfaces for sealant placement. In addition, a 2001 systematic review\(^20\) could not judge definitively the accuracy of radiographic examination to identify carious lesions. Furthermore, evidence suggests that radiographs have low sensitivity and high specificity with regard to the detection of early occlusal lesions.\(^26\) In other words, the early development of caries into enamel and dentin is more likely to be missed than detected. In addition, any improvement in accuracy resulting from the addition of radiographs to a visual assessment of lesion cavitation on occlusal surfaces has not been established.

**Other assessment methods.** During the last decade, researchers have made a concerted effort to identify more technologically advanced methods to detect and quantify demineralization in teeth with noncavitated lesions. Some of these technologies include quantitative light-induced fluorescence (QLF, Inspektor Research Systems, 858 JADA, Vol. 141 http://jada.ada.org July 2010 Copyright © 2010 American Dental Association. All rights reserved. Reprinted by permission.

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**Figure.** Two stages of severity of an occlusal carious lesion. **A.** Noncavitated. **B.** Cavitated.
Amsterdam) and DIAGNOdent (Kavo Dental, Biberach, Germany). These devices aid in the detection and monitoring of noncavitated lesions, but they are not stand-alone methods that can be used in place of the dentist’s clinical judgment. When used correctly, they can play an important role in the diagnosis of lesion activity by monitoring changes across time and helping the dentist stage the severity of a carious lesion.19,44-51 This, in turn, helps the dentist select the most appropriate treatment for a particular patient in a private practice setting. However, because these devices do not help detect lesion cavitation and are expensive, their use is not justified in SBSPs.

Systematic reviews have concluded that these instruments have higher sensitivity (thus, more carious lesions will be detected) but lower specificity (resulting in more false-positive findings—that is, sound surfaces incorrectly classified as carious) than traditional visual assessment methods in the detection of lesions at earlier, non-cavitated stages in the caries process.21,51 In the United States, caries rates have declined among certain age groups12 and caries progression rates have slowed.13 Therefore, the indiscriminant use of these technologies might result in a high number of false-positive findings. Depending on how the user interprets the instrument’s findings, this could result in a decrease in the number of teeth that would benefit from sealants in SBSPs. In addition, these instruments are not helpful in detecting lesion cavitation. Therefore, we cannot recommend the use of advanced caries-detection aids in SBSPs.

**CONCLUSIONS**

We need to make distinctions between assessing children for placement of sealants in SBSPs and assessing them in clinical practice. In clinical practice, the clinician conducts caries risk assessment, diagnosis and treatment planning at the individual tooth level with a high expectation of continuity of care. In school-based programs, the clinician assesses each child, but he or she makes the caries risk assessment at the group level. Regardless of the setting, however, available evidence supports the conclusion that the placement of sealants over noncavitated carious lesions arrests the disease process2,52-56 and is cost effective.57 Furthermore, recent evidence does not justify distinguishing between enamel and dentin caries as the cutoff point for sealant placement, as earlier guidelines have suggested.58 Evidence now supports the detection of cavitation as the point at which sealants are not placed.1,4

To distinguish between noncavitated and cavitated carious lesions, clinicians should use visual assessment. Teeth should be free of debris; clinicians should not use an explorer under force; magnification is not necessary; radiographs are not indicated solely for the placement of sealants, especially in SBSPs targeting children in second through sixth grades; and insufficient evidence exists to recommend other methods to determine the presence or absence of cavitation.

These recommendations are based primarily on an analysis of the literature, including systematic reviews when available, and on the opinions of the CDC expert work group members. Even if a sealant is placed on a tooth with approximal caries that is diagnosed at the child’s next clinical examination, no harm has been done, as the dentist can place a restoration at that time. Moreover, no evidence indicates that placement of a sealant increases caries progression.

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Health care professionals often provide prevention services in schools to protect and promote the health of students.\(^1\) School programs can increase access to services, such as dental sealant placement, especially among vulnerable children less likely to receive private dental care.\(^2\) In addition, school programs have the potential to link students with treatment services in the community and facilitate enrollment of eligible children in public insurance programs, such as Medicaid and the Children’s Health Insurance Program.\(^3\)

In 2001, the independent, non-governmental Task Force on Community Preventive Services completed a systematic review of published scientific studies demonstrating strong evidence that school sealant programs were effective in reducing the incidence of caries.\(^4,5\) The median decrease in occlusal caries in posterior teeth among children aged 6 through 17 years was 60 percent. On the basis of these findings, the task force recommended that school sealant programs be part of a comprehensive community strategy to prevent dental caries.\(^4,5\) These programs typically are implemented in schools that serve children from low-income families and focus primarily on those

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**Abstract**

**Background.** School-based sealant programs (SBSPs) increase sealant use and reduce caries. Programs target schools that serve children from low-income families and focus on sealing newly erupted permanent molars. In 2004 and 2005, the Centers for Disease Control and Prevention (CDC), Atlanta, sponsored meetings of an expert work group to update recommendations for sealant use in SBSPs on the basis of available evidence regarding the effectiveness of sealants on sound and carious pit and fissure surfaces, caries assessment and selected sealant placement techniques, and the risk of caries’ developing in sealed teeth among children who might be lost to follow-up. The work group also identified topics for which additional evidence review was needed.

**Types of Studies Reviewed.** The work group used systematic reviews when available. Since 2005, staff members at CDC and subject-matter experts conducted several independent analyses of topics for which no reviews existed. These reviews include a systematic review of the effectiveness of sealants in managing caries.

**Results.** The evidence supports recommendations to seal sound surfaces and noncavitated lesions, to use visual assessment to detect surface cavitation, to use a toothbrush or handpiece prophylaxis to clean tooth surfaces, and to provide sealants to children even if follow-up cannot be ensured.

**Clinical Implications.** These recommendations are consistent with the current state of the science and provide appropriate guidance for sealant use in SBSPs. This report also may increase practitioners’ awareness of the SBSP as an important and effective public health approach that complements clinical care.

**Key Words.** Caries; evidence-based dentistry; pit-and-fissure sealants; preventive dentistry; public health/community dentistry.

in second and sixth grades, because high percentages of these children are likely to have newly erupted permanent molars.6

Available data show that children aged 6 through 11 years from families living below the federal poverty threshold (approximately $21,800 annually for a family of four in 2008)7 are almost twice as likely to have developed caries in their permanent teeth as are children from families with incomes greater than two times the federal poverty threshold (28 percent versus 16 percent).8 Overall, about 90 percent of carious lesions are found in the pits and fissures of permanent posterior teeth, with molars being the most susceptible tooth type.9,10 Unfortunately, only about one in five children, or 20 percent, aged 6 though 11 years from low-income families has received sealants, a proportion that is notably less than the 40 percent of children from families with incomes greater than two times the poverty threshold.8 Significant disparities also exist according to race/ethnicity, with non-Hispanic African American (21 percent) and Mexican American (24 percent) children aged 6 through 11 years less likely to have received sealants than non-Hispanic white children (36 percent).8

School sealant programs can be an important intervention to increase the receipt of sealants, especially among underserved children. For example, the results of a study in Ohio confirmed that programs directed toward low-income children substantially increased the use of dental sealants.11 Furthermore, sealant programs could reduce or eliminate racial and economic disparities in sealant use if programs were provided to all eligible, high-risk schools,11 such as those in which 50 percent or more of the children are eligible for free or reduced-price meals.6

Differences of opinion among clinicians regarding the management of caries, caries assessment and sealant placement procedures12-14 have led some to question the effectiveness of certain practices, such as sealing teeth that have incipient caries or sealing without first obtaining diagnostic radiographs. Partly on the basis of the need to address these questions, the Association of State and Territorial Dental Directors asked the Centers for Disease Control and Prevention (CDC), Atlanta, to review and update sealant guidelines last revised in 1994.15 Staff members of CDC agreed to undertake this review, especially because new information had become available regarding the effectiveness of sealants, the prevalence of caries and sealants in children and young adults in the United States, and techniques for caries assessment and sealant placement.

This report provides updated recommendations for sealant use in school-based sealant programs (SBSPs) (that is, programs that provide sealants in schools).2 We also inform dental practitioners about the evidence regarding the effectiveness of SBSPs and practices. This evidence provides the basis for the updated recommendations.

Practitioner awareness is important because dentists in private practice likely will see children who have received sealants in school-based programs and might themselves be asked to participate in or even implement such programs. In addition, this report can help address questions from parents, school administrators and other stakeholders. Finally, we discuss the consistency between these recommendations for SBSPs and evidence-based clinical recommendations for sealant use developed recently by an expert panel convened by the American Dental Association (ADA) Council on Scientific Affairs16 (the ADA sealant recommendations).

METHODS

The CDC supported two meetings (in June 2004 and April 2005) of a work group consisting of experts in sealant research, practice and policy, as well as caries assessment, prevention and treatment. The work group also included representatives from professional dental organizations. The work group addressed questions about the following topics (Box):

- effectiveness of sealants on sound and carious pit and fissure surfaces;
- methods for caries assessment before sealant application;
- effectiveness of selected placement techniques;
- risk of developing caries in sealed teeth among children who might be lost to follow-up and for whom sealant retention cannot be ensured.

Based in part on the content of the meeting presentations and discussions, the work group drafted recommendations and identified areas in which additional evidence review was necessary. The work group used published findings of systematic reviews when available. Since the last

ABBREVIATION KEY. ADA: American Dental Association. CDC: Centers for Disease Control and Prevention. IFUs: Instructions for use. RCTs: Randomized controlled trials. SBSPs: School-based sealant programs.
meeting of the group in 2005, staff members of CDC and another expert group completed a systematic review to determine the effectiveness of sealants in managing caries progression and bacterial levels in carious lesions. The results of that review also supported the ADA sealant recommendations. For questions about other topics for which there were no existing reviews, CDC staff members conducted analyses of the available evidence and published these results in peer-reviewed journals.

Clinical studies. For these analyses, we searched electronic databases (that is, MEDLINE, Embase, Cochrane Library and Web of Science) to identify clinical studies that focused primarily on sealant outcomes resulting from different surface preparation and placement techniques. In some cases, few, if any, clinical trials directly compared in the same study sealant retention resulting from different placement techniques. In these situations, we performed bivariate and multivariate analyses to compare sealant retention across studies. For example, we compared sealant retention in studies that involved handpiece prophylaxis with retention in studies that involved toothbrush prophylaxis, and studies that involved a four-handed technique with studies that involved a two-handed technique. Lastly, in light of the work group’s recommendation that clinicians consult manufacturers’ instructions regarding surface preparation before acid etching, we described the range of manufacturers’ instructions for surface preparation for unfilled resin-based sealants, which commonly are used in school programs.

Scientific evidence. For each question addressed by the work group, we summarized the relevant scientific information. On the basis of recognized systems for grading the quality of scientific evidence, we assigned the highest level of confidence generally to findings of systematic reviews and randomized controlled trials (RCTs). Random assignment of study participants to treatment and control groups is the study design most likely to fully control for the effect of other factors on sealant effectiveness or retention. The systematic review involves the use of a standard procedure to synthesize findings from the best available clinical studies, usually RCTs.

We generally assigned lower levels of confidence to findings from studies with other designs. Beyond this qualitative assessment of the evidence, neither the work group nor CDC staff members made any attempt to grade the quality of the evidence or directly relate each recommendation to the strength of the evidence. We did not independently review the design or quality of the systematic reviews and comparative studies. All included studies were published in the peer-reviewed scientific literature.

QUESTIONS AND KEY FINDINGS

The work group addressed the following questions.

Sound pit and fissure surfaces. What is the effectiveness of sealants in preventing the development of caries on sound pit and fissure surfaces?

Systematic reviews have found strong evidence of sealant effectiveness on sound permanent posterior teeth in children and adolescents. A meta-analysis of 10 studies of a one-time placement of autopolymerized sealants on permanent molars in children found that the sealants reduced dental caries by 78 percent at one year and 59 percent at four or more years of follow-up. (A meta-analysis is a review that involves the use of quantitative methods to combine the statistical measures from two or more studies and generates a weighted
The lower estimates might reflect the inclusion of studies that examined sealants polymerized by ultraviolet light (that is, first-generation sealant materials no longer marketed in the United States) and studies involving exposures to other preventive interventions, such as fluoride mouthrinses.

Summary of evidence. Systematic reviews18,26,28,29 have found that sealants are effective in preventing the development of caries on sound pit and fissure surfaces in children and adolescents.

Noncavitated or incipient lesions. What is the effectiveness of sealants in preventing the progression of noncavitated or incipient carious lesions to cavitation?

A meta-analysis of six studies of sealant placement on teeth with noncavitated carious lesions found that sealants reduced by 71 percent the percentage of lesions that progressed up to five years after placement in children, adolescents and young adults.17 We define noncavitated carious lesions as lesions with no discontinuity or break in the enamel surface. Findings across each of the six studies were consistent.

Summary of evidence. A systematic review17 found that pit-and-fissure sealants are effective in reducing the percentage of noncavitated carious lesions that progressed to cavitation in children, adolescents and young adults.

Bacteria levels. What is the effectiveness of sealants in reducing bacteria levels in cavitated carious lesions?

A systematic review of the effects of sealants on bacteria levels in cavitated carious lesions found no significant increases in bacteria under sealants.18 Sealants lowered the number of viable bacteria, including Streptococcus mutans and lactobacilli, by at least 100-fold and reduced the number of lesions with any viable bacteria by about 50 percent.

Summary of evidence. A systematic review18 found that pit-and-fissure sealants are effective in reducing bacteria levels in cavitated carious lesions in children, adolescents and young adults.

Assessment of caries on surfaces to be sealed. Which caries assessment methods should be used in SBSPs to differentiate pit and fissure surfaces that are sound or noncavitated from those that are cavitated or have signs of dentinal caries?

In 2001, investigators conducting a systematic review for the National Institutes of Health Consensus Development Conference on Diagnosis and Management of Dental Caries Throughout Life30 concluded that the relative accuracy of methods of identifying carious lesions could not be determined from the available studies. The systematic review evaluated evidence regarding the following methods: visual inspection, visual/tactile inspection, radiographic assessment, fiber-optic transillumination, electrical conductance and laser fluorescence. The authors also examined the improvement in accuracy resulting from the addition of radiographs to visual assessment in the detection of dentinal lesions on occlusal surfaces.

The review judged the quality of evidence available for assessment of the relative accuracy of the diagnostic methods as “poor.” The authors rated the evidence as poor because there were few relevant studies; the study quality was lower than average and/or the studies included a wide range of observed measures of accuracy. Because of the poor quality of the available evidence, the investigators could not determine the relative accuracy of the assessment methods. Most of the studies compared assessment methods with a histologic determination of caries. For the identification of cavitated lesions, however, the authors of the systematic review also accepted visual or visual/tactile inspection—the principal methods dentists use to identify cavitated lesions—as a valid standard.31,32

More recently, an international team of caries researchers developed an integrated system for caries detection based on a review of the best available evidence and contemporary caries detection criteria.33,34 In this system, clinicians use...
visual criteria alone to document the extent of enamel breakdown, including distinct cavitation into dentin, the presence of an underlying dark shadow from dentin and the exposure of dentin. Researchers have correlated the visual criteria in this integrated system with the extent of carious demineralization into dentin. With this system, clinicians can determine cavitation into dentin or find evidence of dentinal involvement, such as an underlying dark shadow, without extensive drying of the tooth.

Other widely used criteria for epidemiologic and clinical caries studies also have relied on visual and visual/tactile assessment. These criteria describe frank cavitation as “a discontinuity of the enamel surface caused by loss of tooth substance” or an “unmistakable cavity.” In these assessments, the examiner uses an explorer primarily in noncavitated lesions to determine the softness of the floor or walls or the presence of weakened enamel. Findings of clinical and in vitro studies, however, indicate that use of a sharp explorer, even with gentle pressure, can result in defects or cavitations that could introduce a pathway for caries progression.

Technologically advanced tools such as laser fluorescence are designed to assist the dentist in interpreting visual cues in detecting and monitoring lesions over time, especially early noncavitated lesions. Findings of validation studies indicate that these tools increase the percentage of early carious lesions that are detected, but they also increase the likelihood that a sound surface will be described as carious.

Finally, investigators in two in vitro studies assessed changes in the accuracy of detecting carious lesions resulting from the addition of low-powered magnification to unaided visual inspection. One study found that inspection with a x2 magnifying glass did not improve the accuracy of visual inspection alone in the detection of dentinal caries on noncavitated occlusal surfaces. The other study found that the addition of x3.25 loupes to visual inspection alone did improve accuracy in the assessment of occlusal and interproximal surfaces, although more than 90 percent of the clinical decisions to describe a surface as decayed were correct with the use of either technique. The researchers did not report the percentage of clinically decayed surfaces that were limited to enamel or extended into dentin on histologic examination. They also did not document the prevalence of cavitation among the decayed surfaces.

Summary of evidence. In 2001, a systematic review concluded that the relative accuracy of methods used to identify carious lesions could not be determined from the available studies. More recently, a team of international caries researchers supported visual assessment alone to detect the presence of surface cavitation and/or signs of dentinal caries. They based this determination on their review of the best available evidence and on contemporary caries detection criteria.

Published studies have suggested that use of a sharp explorer under pressure could introduce a pathway for caries progression and that use of technologically advanced tools, such as laser fluorescence, increases the likelihood that a sound surface will be deemed carious. Investigators in two in vitro studies could not determine improvement in the accuracy of detecting cavitation or dentinal caries on occlusal surfaces with the addition of low-powered magnification.

Surface preparation. What is the effect of clinical procedures? What is the effect of clinical procedures—specifically, surface cleaning or mechanical preparation methods with use of a bur before acid etching—on sealant retention?

Recent reviews, including one systematic review identified two controlled clinical trials that directly compared surface cleaning methods. Donnan and Ball found no difference in complete sealant retention between surfaces cleaned with a handpiece and prophylaxis brush with pumice and those cleaned with an air-water syringe after the clinician ran an explorer

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along the fissures. Similarly, Gillcrist and colleagues⁴⁶ observed no difference between surfaces cleaned with a handpiece and prophylaxis brush with prophylaxis paste and those cleaned with a dry toothbrush. Reported retention rates were greater than 96 percent at 12 months after sealant placement for all four surface cleaning methods. Furthermore, bivariate and multivariate analyses of retention data from published studies involving the use of supervised toothbrushing by the patient or a handpiece prophylaxis (also called rubber-cup prophylaxis or pumice prophylaxis) by the operator revealed similar, if not higher, retention rates for supervised toothbrushing.¹⁹,²¹

The ADA’s expert panel,¹⁶ in its review of evidence for the ADA sealant recommendations, found “limited and conflicting evidence” that mechanical preparation with a bur results in higher sealant retention rates in children.⁵⁰-⁵² In addition, a systematic review⁴⁷ identified only one controlled clinical trial⁴⁵ that compared use of a bur and acid etching with acid etching alone. The researchers found no difference in sealant retention at 48 months.⁴⁷,⁵³

**Summary of evidence.** The effect of specific surface cleaning or enamel preparation techniques on sealant retention cannot be determined because of the small number of clinical studies comparing specific techniques and, for mechanical preparation with a bur, inconsistent findings. Bivariate and multivariate analyses of retention data¹⁹,²¹ across existing studies suggest that supervised toothbrushing or use of a handpiece prophylaxis may result in similar sealant retention rates over time.

**Four-handed technique for applying dental sealant.** Does use of a four-handed technique in comparison with a two-handed technique improve sealant retention?

The four-handed technique involves the placement of sealants by a primary operator with the assistance of a second person. The two-handed technique is the placement of sealants by a single operator. The work group could not find any direct comparative studies of the four-handed technique versus the two-handed technique with regard to sealant retention or effectiveness.

Furthermore, retention rates in single studies generally reflect multiple factors.¹⁹ For example, Houpt and Shey⁵⁴ reported a sealant retention rate of more than 90 percent at one year in a single study that involved the use of two-handed delivery to apply sealants, while other authors⁵⁵,⁵⁶ reported retention rates of less than 80 percent at one year for single studies in which four-handed delivery was used. Results of a multivariate analysis⁴⁹ of sealant effectiveness studies showed that use of the four-handed technique increased sealant retention by 9 percentage points when the investigators controlled for other factors.

**Summary of evidence.** In the absence of direct comparative studies, the results of a multivariate study of available data¹⁹ suggest that use of the four-handed placement technique is associated with a 9 percentage point increase in sealant retention.

**Caries risk associated with lost sealants.** Are teeth in which sealants are lost at a higher risk of developing caries than are teeth that were never sealed?

A recent meta-analysis of seven RCTs found that teeth with fully or partially lost sealants were not at a higher risk of developing caries than were teeth that were never sealed.²⁰ In addition, although sealant effectiveness in preventing caries is related to retention over time, researchers conducting a systematic review that included only studies in which lost sealants were not reapplied found that sealants reduced caries by more than 70 percent.²⁰,²⁶ Thus, children from low-income families, who are more likely to move between schools than are their higher-income counterparts,⁵⁷,⁵⁸ will not be placed at a higher risk of developing caries because they missed planned opportunities for sealant reapplication in SBSPs.

**Summary of evidence.** Findings from a meta-analysis²⁰ indicate that the caries risk for sealed teeth that have lost some or all sealant does not exceed the caries risk for never-sealed teeth. Thus, the potential risk associated with loss to follow-up for children in school-based programs does not outweigh the potential benefit of dental sealants.

**RECOMMENDATIONS FOR SCHOOL-BASED SEALANT PROGRAMS**

The table presents the recommendations of the work group. These are based on the best available scientific evidence and are an update to earlier guidelines.¹⁵ They provide guidance regarding planning, implementing and evaluating SBSPs and should be helpful for dental professionals working with sealant programs.
TABLE

Recommendations for school-based sealant programs.

<table>
<thead>
<tr>
<th>Indications for Sealant Placement</th>
<th>RECOMMENDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean the tooth surface.</td>
<td>Seal sound and noncavitated pit and fissure surfaces of posterior teeth, with first and second permanent molars receiving highest priority.</td>
</tr>
<tr>
<td>Differentiate cavitated and noncavitated lesions.</td>
<td>Unaided visual assessment is appropriate and adequate.</td>
</tr>
<tr>
<td>Dry teeth before assessment with cotton rolls, gauze or, when available, compressed air.</td>
<td>An explorer may be used to gently confirm cavitations (that is, breaks in the continuity of the surface); do not use a sharp explorer under force.</td>
</tr>
<tr>
<td>Seal sound and noncavitated pit and fissure surfaces of posterior teeth, with first and second permanent molars receiving highest priority.</td>
<td>Radiographs are unnecessary solely for sealant placement.</td>
</tr>
<tr>
<td>Additional surface preparation methods, such as air abrasion or enameloplasty, are not recommended.</td>
<td>Other diagnostic technologies are not required.</td>
</tr>
</tbody>
</table>

DISCUSSION

In the updated recommendations in this report, we use the presence or absence of surface cavitation as a key factor in the decision to apply sealant to the tooth surface. These recommendations complement the ADA sealant recommendations and are consistent with them on virtually all topics addressed by both (for example, sealing teeth that have noncavitated lesions and using a four-handed technique when possible).

The effectiveness of sealants in preventing the development of caries is well established. Findings of a recent systematic review also confirmed that sealants are effective in managing early carious lesions by reducing the percentage of noncavitated lesions that progress to cavitation and by lowering bacteria levels in carious lesions. These results should ease practitioners' concerns that placement of sealants on pit and fissure surfaces with early or incipient noncavitated carious lesions or on surfaces of questionable caries status is not beneficial.

One notable difference between the recommendations for sealant use in clinical versus school settings concerns the approach to caries risk assessment. Clinicians periodically assess caries risk at the level of the patient or the tooth to determine if sealant placement is indicated as a primary preventive measure. In SBSPs, clinicians also must consider risk at the level of the school and community. Local and state health departments commonly use the percentage of children participating in the free or reduced-cost federal meal program as a proxy for income to prioritize schools for sealant programs.

As described earlier in this report, children from low-income families are at a higher risk of developing caries than are children from wealthier families. Caries risk among children from low-income families is sufficiently high to justify sealing all eligible permanent molars and is the most cost-effective prevention strategy. Furthermore, providing sealants only to children in a free or reduced-cost lunch program is viewed as stigmatizing and is unacceptable in many schools and communities.
less than two times the federal poverty threshold had a dental visit in the previous year compared with about 70 percent of their higher-income counterparts.\textsuperscript{61}

As resources allow, SBSPs work with partners, such as local dental practices, public health clinics, parents, school nurses and local dental associations, to help students without a source of dental care receive comprehensive dental services. For children with cavitated lesions who are unlikely to receive treatment services promptly, dental practitioners in SBSPs may choose to use interim treatment strategies. These could include application of sealants for small cavitations with no visually detectable signs of dental caries and atraumatic restorative procedures for larger carious lesions.\textsuperscript{15,62-64}

The following information might be helpful for practitioners who see children who have received sealants through SBSPs. First, sealants do not eliminate dental caries but predictably reduce the occurrence of disease. Thus, practitioners might observe a child with a permanent molar sealed in a school program in which caries has developed. They should keep in mind that the failure to prevent caries in that one sealed tooth does not constitute failure of the entire school sealant program. Similarly, the failure of a sealant to prevent caries in a patient treated in a private dental practice does not constitute failure of the entire sealant protocol. Available evidence consistently indicates that the overall incidence of caries in permanent molars is lower among children who received sealants compared with the incidence in similar children who did not.\textsuperscript{5,26,28,29} Finally, sealant placement is a reversible procedure that easily allows the dentist to administer additional caries management and treatment strategies, such as placement of a restoration, if needed.

In preparing these recommendations, the work group and CDC staff members also reviewed assessment methods for tooth surfaces in SBSPs. Visual assessment for the detection of cavitation is supported by many international experts.\textsuperscript{23,65} Most SBSPs target children with newly erupted permanent molars. The low likelihood of caries in these newly erupted teeth, along with recommendations to seal both sound surfaces and those with noncavitated lesions, argue against the use of radiographs or technologically advanced tools to detect cavitated lesions in children in SBSPs.

Furthermore, when the likelihood of caries is low, such as in newly erupted molars, these modalities might increase the possibility that a sound surface will be misclassified as carious and be restored prematurely.\textsuperscript{16,32} Thus, these teeth might not receive the preventive benefit of a sealant. In addition, children in SBSPs who are in need of treatment services will be referred to private dental offices or public dental clinics where dentists will obtain radiographs as necessary—and in accordance with current ADA/U.S. Food and Drug Administration guidelines\textsuperscript{66}—and conduct additional diagnostic procedures, as appropriate.

The essential steps in placement of unfilled resin-based sealants include cleaning pits and fissures, acid etching tooth surfaces and maintaining a dry field while the sealant is placed and cured.\textsuperscript{16} Available evidence suggests that cleaning pits and fissures with a toothbrush by the patient under supervision or with a handpiece prophylaxis by the operator results in similar sealant retention rates.\textsuperscript{19,21,47,48}

Application of a hydrophilic bonding agent between the etched surface and the sealant is a supplemental technique that is not used routinely in SBSPs, and the work group did not evaluate the technique. The ADA’s expert panel reviewed the evidence, developed guidance for practitioners and described current types of bonding systems.\textsuperscript{16} The ADA panel noted that use of currently available self-etching bonding agents that do not include a separate etching step might result in lower retention than that achieved with the standard acid-etching technique and is not recommended.\textsuperscript{16} In addition, the bonding agent must be compatible with the sealant material.

The work group also reaffirmed the importance of evaluating sealants after placement, but it stressed that children for whom follow-up cannot be ensured should still receive sealants. A recent meta-analysis found that teeth with partially or completely lost sealants were at no greater risk of developing dental caries than were teeth that were never sealed.\textsuperscript{20} Dental professionals can check sealant retention among a sample of participants in an SBSP shortly after placement to ensure the quality of the procedure and materials.
used.\textsuperscript{22} They also can check sealant retention and integrity during the following school year and seal any permanent molars that might have erupted since the procedure. The timing of the evaluation of sealant retention and integrity can depend on several factors, such as local program objectives; changes in dental materials, techniques or personnel; and student movement in and out of the school and school district.

**CONCLUSION**

The recommendations of the expert work group update earlier guidelines for SBSPs and support practices that are appropriate, feasible and based on the best available scientific evidence. These updated recommendations, along with the supporting rationale, should increase practitioners’ awareness of the SBSP as an important and effective public health approach that complements clinical care systems in promoting the oral health of children and adolescents.\textsuperscript{1,23,24}

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Exploring four-handed delivery and retention of resin-based sealants

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Background. To date, no trials have been published that examine whether four-handed delivery of dental sealants increases their retention and effectiveness. In the absence of comparative studies, the authors used available data to explore the likelihood that four-handed delivery increased sealant retention.

Methods. The authors examined data regarding the retention of autopolymerized resin-based sealants from studies included in systematic reviews of sealant effectiveness. The explanatory variable of primary interest was the presence of a second operator. To examine the unique contribution of four-handed delivery to sealant retention, the authors used linear regression models.

Results. Eleven of the 36 studies from systematic reviews met explicit criteria and were included in this analysis. The high level of heterogeneity among studies suggested that multivariate analysis was the correct approach. According to the regression model, the presence of a second operator increased retention by 9 percentage points.

Conclusions. For this group of studies, four-handed delivery of autopolymerized sealants was associated with increased sealant retention.

Clinical Implications. Using four-handed delivery to place resin-based sealants may increase retention.

Key Words. Pit-and-fissure sealants; sealant retention; four-handed delivery.

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United States, almost 94 percent of dentists reported in a recent ADA survey of dental practice that they employed a chairside assistant.³

A recent systematic review that examined the retention of resin-based pit-and-fissure sealants according to different clinical procedures used during sealant delivery, however, did not address two-handed versus four-handed delivery.⁴ In addition, the ADA conducted a Medline search of the literature from 1975 through 2006, which identified no studies that directly compared sealant outcomes associated with two- and four-handed delivery (Julie Frantsve-Hawley, RDH, PhD, ADA Division of Science, director, Research Institute and Center for Evidence-based Dentistry and Helen Ristic, PhD, ADA Division of Science, director, scientific information, oral communication, January 2007). (The search strategy is available from the authors on request.) Theoretical rationale and expert opinion support the use of a trained auxiliary during sealant placement.⁵ The four-handed technique may improve the quality and efficiency of sealant placement through shortened placement time, improved isolation, reduction in operator fatigue and enhanced patient care.⁵,⁶,¹⁰

While we could find no comparative studies directly estimating improvements in outcomes associated with the use of an assistant, the studies included in systematic reviews of sealant effectiveness offer a potentially rich source of relevant information. These studies have met established rules of study design, conduct and measurement for inclusion in final bodies of evidence. In addition, they usually provide a detailed description of the intervention (for example, the preparation and placement procedures) and outcomes, in addition to the study participants, the time period and the setting.

A multivariate analysis of the association between the outcome in these studies (sealant retention) and four-handed delivery, in addition to other preparation and placement procedures, can provide indirect evidence of possible benefits. In the absence of randomized controlled trials, a multivariate approach can control for the effects of potential confounders measured in the studies, as well as provide estimates of the unique contribution of each procedure (such as four-handed delivery). Because such approaches may not account for all confounders, however, findings provide only indirect evidence of possible benefit. Information about the contribution of selected aspects of the sealant delivery protocol is important for clinical and public health decision making.

The primary objective of this secondary data analysis was to determine whether evidence existed that sealant retention increased with four-handed placement, while controlling for other factors that could affect retention. We chose retention instead of effectiveness as the outcome of interest, because retention would be affected less by differences in caries risk among the sample populations of multiple studies. In addition, the effectiveness of resin-based sealants is highly associated with retention, because these sealants act by providing a physical barrier that prevents microorganisms and food particles from collecting in pits and fissures.¹¹

**METHODS**

**Definitions.** We defined four-handed delivery as the placement of sealants by a primary operator with a second person present to provide assistance. Similarly, we defined two-handed delivery as the placement of sealants by a single operator. We used World Bank designations to classify countries where the studies were conducted as “high” income or “not high” income (a combination of low income, lower middle income and upper middle income).¹²

**Inclusion criteria.** We searched Medline and the Cochrane Library for systematic reviews of sealant effectiveness that were published in English between 1990 and 2005. Four systematic reviews,¹³-¹⁶ which included 36 unique studies, met these inclusion criteria.¹⁷-⁵² One reviewer (S.K.G.) screened these studies, and she excluded 25-⁵² for the following reasons: the study was not published in English; the study design was not a prospective cohort or randomized controlled trial; the study did not apply second- or third-generation sealant material; subjects were not between 5 and 10 years of age; the study contained insufficient information to estimate both the percentage of sealants that...
were retained fully on permanent first molars according to year since placement and the standard errors (SEs) for these estimates; mechanical preparation, such as enameloplasty or fissureotomy, was performed before sealant placement; or lost or fractured sealant material was repaired or reapplied.

Data abstraction. The same reviewer (S.K.G.) abstracted the studies meeting the inclusion criteria. The abstraction form included the following factors hypothesized to be associated with sealant retention:
- two- or four-handed delivery;
- years since placement (for example, one, two or three);
- tooth-surface cleaning method (toothbrush or handpiece);
- isolation by cotton rolls or a rubber dam;
- type of suction;
- use of acid-etching and/or a bonding agent;
- type of primary operator (dentist or nondentist);
- income level of the country (high or not high).

We included the last factor to explore the assumption that greater access to and utilization of dental services, as well as differences in dental systems in higher-income countries, would increase the detection of incipient caries in sealed teeth. We contacted the authors of the studies to verify information about the conduct of the study if adequate detail was not provided in published reports.

Quality assessment. Because we selected studies from published systematic reviews that had explicit quality criteria for inclusion, we did not reassess all aspects of individual study quality but did document two selected quality aspects: number of primary operators and whether operators received training before delivering sealants to study subjects. It is important to remember that, to our knowledge, there are no comparative studies of sealant outcomes for two-versus four-handed placement and, thus, some commonly used criteria to determine study quality such as random allocation would not necessarily apply.

Outcome measure and data adjustment. Our outcome measure was retention at each annual follow-up examination of sealants that were placed on occlusal surfaces of first permanent molars. We defined retention as the presence of a sealant that completely covered the pits and fissures of the tooth. We used the following formula to calculate the SE of the retention rate:

\[
SE = \sqrt{\frac{\text{retention} \times (1 - \text{retention})}{n}}
\]

where “n” represents the number of teeth initially sealed.

Because teeth in the same subject may be correlated with each other, conducting the analysis at the tooth level may have underestimated SEs. If a study provided only site-level retention data (for example, examiners reported multiple sites on individual teeth, such as buccolingual pits and mesiodistal occlusal pits), we used the reported retention rate but calculated the SE using the reported number of teeth instead of tooth sites. This adjustment resulted in higher SEs for studies using tooth sites as the unit of analysis.

Analysis. We calculated the summary-weighted retention rate separately for the studies that used two- and four-handed delivery for each of the three years after sealant placement. We weighted the studies by the reciprocal of their squared SE. To determine whether it was reasonable to pool the studies to attain a summary estimate of retention according to the presence or absence of a second operator for each of the three years, we examined whether the confidence intervals on the forest plots overlapped for studies using two-handed delivery and for those using four-handed delivery.

We used weighted linear regression models to examine the effect of four-handed delivery alone (model 1) and in the presence of other hypothesized factors (model 2) on sealant retention for each year since placement. All explanatory factors were represented in the regression model as dichotomous independent variables, where “1” indicates the presence of the factor and “0” indicates the absence of the factor. We excluded hypothesized factors that were present in only one study, because the variable might have reflected other unique aspects of a single study. We considered explanatory variables to be significant if the P value for the coefficient was less than or equal to .05.

Because we had several possible combinations of explanatory variables and a small sample of studies, we constructed a tree diagram to determine for which combinations of variables we had studies. We also compared the explanatory power of model 1 (that is, how much total variation was
explained by the model as measured by the adjusted $R^2$ with that of model 2. We also reran the regression without the weights to determine whether the results still held when we weighted all of the studies equally.

**RESULTS**

We included 11 studies in the final body of evidence (Table 1). Eight studies used four-handed delivery (representing 1,189 children and 1,944 teeth), while three used two-handed delivery (representing 885 children and 1,000 teeth). In nine studies, the operator performed prophylaxis using a handpiece (with pumice or prophylaxis paste) before placing the sealant. In two studies, the operator cleaned the tooth surfaces with a toothbrush and toothpaste. In six studies, dentists were the primary operators. Seven studies were conducted in high-income countries. Most studies began between 1973 and 1995. Four of the seven studies conducted in high-income countries began between 1973 and 1976. Of the remaining three studies, two likely began in 1977. The four studies published in countries with not-high incomes began between 1975 and 1995.

We found little or no variation for several factors. All studies used cotton rolls and/or high- or low-volume suction to isolate the surface; acid-
etching before sealant placement; and autopolymerized resin-based sealants applied to the occlusal surfaces of permanent first molars in both arches.

**Retention rates.** Summary retention rates for one, two and three years after placement were 89.0 percent (range, 73.4 to 94.6 percent), 81.2 percent (range, 59.5 to 88.9 percent) and 73.9 percent (range, 60.1 to 87.5 percent), respectively. Retention appeared to vary significantly according to study for both two- and four-handed studies (Figure). Summary retention rates for studies using four-handed delivery—equaling 89.8 percent after one year, 83.0 percent after two years and 83.0 percent after three years—were higher than summary retention rates for studies using two-handed delivery (equaling 84.8 percent after one year, 72.4 percent after two years and 67.9 percent after three years) (data not shown). For the regression model that included four-handed delivery and the time since sealant placement as explanatory variables (model 1 in Table 2 (page 287); 28 observations), the adjusted $R^2$ was 42 percent and the coefficient for four-handed delivery approached significance ($P = .055$).

**Explanatory variables.** Stratifying studies according to four explanatory variables (four-handed delivery, surface cleaning via handpiece prophylaxis, dentist as the primary operator and country income) revealed several combinations of these variables for which there were no studies (Table 3, page 287). The included studies provided data for seven of the 16 possible combinations of explanatory variables. Because there were no studies in lower-income countries that used two-handed delivery and, thus, would add no direct information about the impact of four-handed delivery, we ran the regression model for all of the studies and for studies that were conducted in a high-income country. These seven studies conducted in high-income countries provided 18 observations of sealant retention over three years since placement; three studies used two-handed delivery and four studies used four-handed delivery.

### Table 1 (Continued)

<table>
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<tr>
<th>STUDY AUTHOR, YEAR STUDY BEGAN, SITE</th>
<th>Poulsen and Colleagues (Damascus, Syria)</th>
<th>Gibson and Colleagues (Year Not Reported) (Vancouver, British Columbia)</th>
<th>Rock and Bradnock (Year Not Reported) (Birmingham, England)</th>
<th>Thylstrup and Poulsen (Hillerod, Denmark)</th>
<th>Vrbic 1979 (Slovenia)</th>
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<td>One</td>
<td>One</td>
<td>Six</td>
<td></td>
</tr>
<tr>
<td>NA</td>
<td>CR, suction</td>
<td>CR, air-water syringe and high-volume aspirator</td>
<td>CR, low- and high-volume suction</td>
<td>Low-volume suction</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Second-graders</td>
<td>6-7</td>
<td>7</td>
<td>Kindergarten</td>
<td></td>
</tr>
<tr>
<td>121</td>
<td>246</td>
<td>65</td>
<td>190</td>
<td>244</td>
<td></td>
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<tr>
<td>121</td>
<td>393</td>
<td>130</td>
<td>305</td>
<td>373</td>
<td></td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>NR</td>
<td>451</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>1,696</td>
<td>4,217</td>
<td>686</td>
<td>1,562</td>
<td>5,068</td>
<td></td>
</tr>
</tbody>
</table>
delivery (Table 3). Five of these seven studies used a handpiece prophylaxis, all with prophylaxis paste.

When we included all of the studies, the adjusted $R^2$ was 0.69, and when we excluded the studies from countries that were not high-income (model 2 in Table 2), the adjusted $R^2$ was 0.81. Four-handed delivery increased sealant retention by a statistically significant 9 percentage points when compared with toothbrush prophylaxis. Of the nine studies in the regression analysis that reported the use of a handpiece prophylaxis, five used prophylaxis paste, three used pumice and one did not specify. It is possible that some prophylaxis pastes marketed in the 1970s and 1980s may have contained oils or other substances that decreased sealant retention.

DISCUSSION

The findings of this multivariate analysis indicate that, in comparison with two-handed delivery, four-handed delivery increased sealant retention by about 9 percentage points. It is important to note that we identified this positive association only when the variation in other selected factors (that is, time since sealant placement, provider type and surface cleaning method) was controlled across the studies. In contrast, the simple sealant retention rates in an individual study reflect multiple factors, and, thus, retention rates of more than 90 percent at one year for sealants placed in a study with two-handed delivery or less than 80 percent in a study with four-handed delivery can be expected.

The forest plots suggest that significant heterogeneity existed among studies even after we stratified them according to the presence of a second operator. This likely reflects the multiple factors that can affect retention and thus indicated that the multivariate analysis, which controlled for the effects of some of these factors, was the appropriate approach. The high $R^2$—ranging from 69 to 81 percent—for the final regression models indicates that these models included important variables affecting sealant retention in this group of studies.

The findings for some of the other variables in the model also were consistent with the initial hypotheses. First, sealant retention decreased over time. Three years after placement, about 15 percent of the sealants were completely or partially lost. In addition, sealants were less likely to be retained over time in high-income countries. As described above, greater use of dental services in these countries may have increased the probability of detecting caries in sealed teeth.

Unexpected findings. Certain findings of our analysis were unexpected. We found that handpiece prophylaxis was associated with a reduction in sealant retention of about 20 percentage points when compared with toothbrush prophylaxis. Of the nine studies in the regression analysis that reported the use of a handpiece prophylaxis, five used prophylaxis paste, three used pumice and one did not specify. It is possible that some prophylaxis pastes marketed in the 1970s and 1980s may have contained oils or other substances that...
interfered with bonding. In addition, prophylaxis paste, along with pumice, may have been difficult to remove completely from the enamel surface before etching. In 1998, a study comparing toothbrush prophylaxis (with no toothpaste) with handpiece prophylaxis (with prophylaxis paste) reported similar rates of sealant retention—all greater than 97 percent—after one year.  

Another unexpected finding was the association between having a dentist as the primary

| TABLE 2 |

Coefficients associated with sealant retention ($P < .05$) in fixed-effects weighted least-squares regression models.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>COEFFICIENT (STANDARD ERROR)</th>
<th>All Studies</th>
<th>High-Income Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
<td>Model 1</td>
</tr>
<tr>
<td>Intercept*</td>
<td>0.83 (0.04)</td>
<td>1.01 (0.05)</td>
<td>0.84 (0.04)</td>
</tr>
<tr>
<td>Two Years Since Placement</td>
<td>−0.08 (0.03)</td>
<td>−0.07 (0.02)</td>
<td>−0.09 (-0.05)</td>
</tr>
<tr>
<td>Three Years Since Placement</td>
<td>−0.14 (0.04)</td>
<td>−0.14 (0.03)</td>
<td>−0.16 (0.05)</td>
</tr>
<tr>
<td>Four-Handed Delivery</td>
<td>NA†</td>
<td>0.09 (0.03)</td>
<td>0.04 (0.02)</td>
</tr>
<tr>
<td>High-Income Country</td>
<td>NA</td>
<td>−0.07 (0.03)</td>
<td>NA</td>
</tr>
<tr>
<td>Handpiece Prophylaxis</td>
<td>NA</td>
<td>−0.16 (0.03)</td>
<td>NA</td>
</tr>
<tr>
<td>Dentist Delivered Sealants</td>
<td>NA</td>
<td>−0.07 (0.03)</td>
<td>NA</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.42</td>
<td>0.69</td>
<td>0.41</td>
</tr>
</tbody>
</table>

* One-year retention for studies using two-handed delivery and a toothbrush prophylaxis. None of the included studies had all of the characteristics.
† NA: Not applicable.

| TABLE 3 |

Studies stratified according to four factors hypothesized to be associated with sealant retention.

<table>
<thead>
<tr>
<th>HIGH-INCOME COUNTRY</th>
<th>Handpiece Prophylaxis</th>
<th>No Handpiece Prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dentist operator</td>
<td>Nondentist operator</td>
<td>Dentist operator</td>
</tr>
<tr>
<td>Four-Handed</td>
<td>Two-Handed</td>
<td>Four-Handed</td>
</tr>
<tr>
<td>Charbeneau and Dennison$^{19}$</td>
<td>NA*</td>
<td>Gibson and colleagues$^{24}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock and Bradnock$^{25}$</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOT-HIGH-INCOME COUNTRY</th>
<th>Handpiece Prophylaxis</th>
<th>No Handpiece Prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dentist operator</td>
<td>Nondentist operator</td>
<td>Dentist operator</td>
</tr>
<tr>
<td>Four-Handed</td>
<td>Two-Handed</td>
<td>Four-Handed</td>
</tr>
<tr>
<td>Erdogan and Alaçam$^{20}$</td>
<td>NA</td>
<td>McCune and colleagues$^{17}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vrbic$^{27}$</td>
<td>NA</td>
<td>Poulsen and colleagues$^{23}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Not applicable.
operator and lower sealant retention rates. The prevalence of sealant placement in the United States through the early 1990s, however, was less than 20 percent. This suggests that many operators likely had limited experience with sealant materials and/or placement techniques. The studies in which dentists were the primary operators may have been less likely to provide training in sealant placement than the studies in which the primary operators were nondentists for two possible reasons.

First, the investigators may have assumed that training was unnecessary because dentists generally have exceptional familiarity with restorative materials and techniques; moreover, even as early as the 1970s and 1980s, they were increasingly using resin-based composite materials. During that time, however, placement of resin-based composite materials generally was limited to restorations on smooth surfaces (that is, Class III, IV and V) with prepared margins. In the absence of training, some of the dentist operators and auxiliaries may not have appreciated fully the meticulousness and attention to detail that are required for successful sealant placement on pit-and-fissure surfaces.

Second, the opportunity cost of training time, as measured by foregone wages, would be higher for dentists than for nondentists. We cannot test this hypothesis because only three of the studies in this analysis specifically described the use of training before sealant placement. In the one study in which the dentists were trained, the retention rate was high, ranging from 95 percent at one year to 80 percent at three years after a one-time placement of sealants.18

Study limitations. This study and its underlying methodology have limitations. First, our comparison of the subgroups was observational. In the absence of random assignment in studies that were designed to directly compare sealant placement outcomes according to two- and four-handed delivery, the association between retention and an explanatory variable might have been due to another omitted causal variable, commonly known as confounding. Confounding may have been mitigated, however, because we used a multivariate analysis that attempted to control for key factors that are relevant to sealant retention.

Second, we did not have studies for all of the possible combinations of study factors, and there were, at most, two studies for any combination of factors. However, although the findings cannot be considered to be definitive because of potential confounding and the limited number of studies, the $R^2$ value suggests that, for this group of studies, the factors included in the model had good predictive power.

Third, our findings may be subject to recall bias because we contacted authors to obtain additional information if adequate data were not included in their report. For example, only five of the 11 studies reported the main explanatory variable—number of operators—in the original report.

Finally, our search universe was limited to studies included in systematic reviews of sealant effectiveness, and only one reviewer screened these studies. For this exploratory analysis, we chose a less resource-intensive method to identify and screen potential studies. In the absence of published comparative studies, this approach is attractive because it provides an efficient method of collecting data from well-conducted studies. The studies included in systematic reviews have met rules of study design, conduct and measurement. In addition, we minimized bias in selecting studies for the current analysis, because the universe of studies was determined by authors of the original systematic reviews. Inclusion and exclusion criteria in this analysis were objective and were specified before we screened available studies. Findings may be useful in developing hypotheses and directing resources for further research.

CONCLUSIONS

For this group of 11 studies, four-handed delivery was associated with higher retention of resin-based sealants. Although these descriptive findings cannot be generalized to all settings, they justify allocating resources to studies that directly compare sealant placement outcomes using two- and four-handed delivery.

Disclosure: None of the authors reported any disclosures.
5. Waggoner WP, Siegel M. Pit and fissure sealant application: updating the technique. JADA 1996;127(3):351-361.
The effect of dental sealants on bacteria levels in caries lesions
A review of the evidence

Ella M. Oong, DMD, MPH; Susan O. Griffin, PhD; William G. Kohn, DDS; Barbara F. Gooch, DMD, MPH; Page W. Caufield, DDS, PhD

Strong evidence shows that sealants are effective in preventing caries in children at varying degrees of risk. Moreover, despite this evidence of effectiveness, sealant prevalence among lower-income children (who are at higher risk of experiencing dental caries) remains at around 30 percent, well below the Healthy People 2010 objective of 50 percent. Survey data of dentists suggest that one of the major barriers to their providing sealants is concern about inadvertently sealing over caries. This concern has become an obstacle to implementation of school-based sealant programs. Documenting the effectiveness of placing sealants over existing caries, thus, is important, because such documentation could remove a barrier to providing a proven intervention.

Dental caries is an infectious and transmissible disease, caused by cariogenic bacteria of the oral cavity, specifically those colonizing the surfaces of teeth. Caries lesions may be caused by a range of bacteria, but principal among the cariogenic flora are the mutans streptococci and lactobacilli. It long has been hypothesized that sealing an existing lesion from contact with the oral fluids should lead to eventual reduction and even death of these organisms and, hence, reduce the need for treatment. The objective of the authors’ review was to examine the evidence of effectiveness of sealants on bacteria levels in caries lesions.

Methods. The authors searched electronic databases for comparative studies examining bacteria levels in sealed permanent teeth. To measure the effect of sealants on bacteria levels, they used the log10 reduction in mean total viable bacteria counts (VBC) between sealed and not-sealed caries and the percentage reduction in the proportion of samples with viable bacteria.

Results. Six studies—three randomized controlled trials, two controlled trials and one before-and-after study—were included in the analysis. Although studies differed considerably, there were no findings of significant increases in bacteria under sealants. Sealing caries was associated with a 100-fold reduction in mean total VBC (four studies, 138 samples). Sealants reduced the probability of viable bacteria by about 50 percent (four studies, 117 samples).

Conclusions. The authors found that sealants reduced bacteria in carious lesions, but in some studies, low levels of bacteria persisted. These findings do not support reported concerns about poorer outcomes associated with inadvertently sealing over caries.

Clinical Implications. Practitioners should not be reluctant to provide sealants—an intervention proven to be highly effective in preventing caries—because of concerns about inadvertently sealing over caries.

Key Words. Pit-and-fissure sealants; caries; bacteria.

JADA 2008;139(3):271-278.
thereby, should arrest the lesion’s progress.²¹ Accordingly, the fate of bacteria in caries lesions that are purposely sealed over has been of great interest to researchers and clinicians alike.

Therefore, we undertook a systematic review of the evidence regarding the effectiveness of sealants in stabilizing or reducing bacteria levels in caries lesions. This study is part of a larger systematic review that examined the effectiveness of sealants in managing caries in the pits and fissures of permanent teeth. Another report from this review found that dental sealants reduced the probability of caries progression by more than 70 percent compared with untreated control teeth.²²

**METHODS**

Inclusion criteria. This analysis was part of a broader systematic review of sealant effectiveness in known carious lesions in the pits and fissures of permanent teeth. Initially, we included all in vivo studies published in English that compared outcomes, such as caries progression or bacteria levels, in permanent teeth treated with sealants with outcomes in permanent teeth not treated with sealants. Comparisons could involve concurrent randomized controlled trials (RCTs), controlled trials or cohort studies (prospective or retrospective) or studies conducted across time (before-and-after, time series) in the same groups. In this analysis, we included comparative studies that examined bacteria viability in sealed carious lesions. There were no restrictions regarding study populations.

Identification of studies. Details of our search strategy and results have been described elsewhere.²³ Two reviewers (B.G. and S.G.) independently examined the titles and abstracts of the 1,905 unique records identified in our search for primary studies or systematic or narrative reviews of the effectiveness of sealants in preventing or treating caries. Of these records, we ordered 262 articles; from our examination of their references, we ordered an additional 49 articles, for a total of 311.

Study selection. Three reviewers (B.G., S.G. and W.K.) reached a consensus that of these 311 articles, 26 studies should be evaluated further. These three reviewers rejected seven studies for inclusion for the following reasons: they were case studies, lacked appropriate outcomes or did not include both baseline and follow-up examinations. Of the 19 studies included in the larger systematic review, nine included data on bacteria levels under sealed carious lesions; of these nine studies, six had sufficient data from which to calculate outcome measures. The Quality of Reporting of Meta-Analyses Flow Diagram for the original, larger study has been published elsewhere.²⁴

Data abstraction and quality assessment. Two reviewers (S.G. and E.O.) abstracted studies by using a modified version of a form developed for the National Institutes of Health Caries Consensus Development Conference in 2001.²⁵ This form was used in a systematic review of methods to manage caries.²⁶ We made one notable modification to the form to collect detailed information about bacteria-sampling methodology. The abstractors collected information to document study quality (in terms of such characteristics as study design, dropout rate, examiner blinding and bacteria-sampling methodology).

Outcome measures. We used two outcomes—mean viable bacteria count (VBC) as measured with colony-forming units per milligram (CFU/mg) and percentage of samples with VBC greater than zero—to measure activity for total bacteria, *Streptococcus mutans* and lactobacilli. To evaluate the effect of sealants on mean VBC, we examined the change in log₁₀ mean VBC (= log₁₀ mean VBCSEALED – log₁₀ mean VBCNOT-SEALED, where a log₁₀ mean VBC value of 6 equals 1 × 10⁶, or 1,000,000 CFU) and whether the difference in mean VBC for sealed and unsealed teeth was significant (P < .05). To measure the effect of sealants on the percentage of samples with VBC greater than zero, we used the percentage change in proportion of samples having VBC greater than zero:

\[
\left( \frac{\% \text{ samples VBC > 0 SEALED}}{\% \text{ samples VBC > 0 NOT SEALED}} - 1 \right) \times 100
\]

Synthesis of findings. We report the overall median and mean effect measures across all studies. We did not calculate confidence intervals for these summary measures because we included multiple observations from the same study, so observations likely were not independent.

RESULTS

Description of studies. Of the six studies used to calculate outcome measures in this analysis (representing 303 bacteria samples), two studies were RCTs, and one was a subgroup analysis of an RCT of split-mouth design. Two were controlled trials that did not mention randomization and one was of a before-and-after design (in which the same tooth was sampled before and after sealant placement)19 (Table 1).

About 94 percent of sampled lesions were cavitated (that is, allowed explorer penetration, had visible cavitation or had radiographic evidence of lesion depth ranging from the dentinoenamel junction [DEJ] to the dentin-pulp border but without pulpal involvement). The remaining 6 percent of lesions most likely were noncavitated (that is, they permitted the explorer probe to catch without penetration or sticking). In four studies, unsealed teeth likely had been carious for a shorter time than had sealed teeth.14-17 Bacterial samples from unsealed teeth were obtained at baseline while samples from sealed teeth were obtained at follow-up or, for the one study in which all bacteria samples were obtained at follow-up, unsealed teeth were diagnosed as carious at follow-up while sealed teeth were diagnosed at baseline.14 Three studies used polymerized, resin-based sealant (RBS), and two used autopolymerized RBS and one used both glass-ionomer cement (GIC) and visible-light–polymerized RBS. Study populations included children, adolescents and young adults, ranging in age from 6 to 25 years.

Sealant effectiveness: total bacteria. We used results from four studies (18 observation points across five years representing 254 samples) to examine the effect of sealants on VBC.14-16,19 There were no findings of significant increases in total bacteria under sealants. The reduction in log_{10} mean VBC at the last period in each study was approximately three in two studies and two in the remaining two studies (one of these two studies reported the median not the mean value). The overall median and mean reductions were 3.01 and 2.56 (138 samples), respectively (Table 2, page 275), and appeared to increase as time since sealant placement increased. Mean total VBC was lower for sealed teeth than for unsealed teeth in the three studies that tested for statistical significance.14-16

Four studies (nine observations across five years representing 117 samples) reported the proportion of samples with viable bacteria from sealed and unsealed caries lesions. The reduction in the proportion of samples with viable bacteria attributable to sealants ranged from zero percent to 100.0 percent, with a median value of 50.0 percent and a mean value of 51.6 percent (Table 3, page 276). In all but one study, lesions were sealed with a maximum depth of one-half of the distance from the DEJ to the pulp. In that study, however, the researchers presented findings for both moderate dentinal lesions ranging in depth from the DEJ to one-fourth the distance from the DEJ to the dentin-pulp border and deep dentinal lesions ranging in depth from one-fourth the distance from the DEJ to the pulp to the full distance from the DEJ to the pulp. If we were to exclude the findings for deep dentinal lesions, then the median and mean reduction in percentage of samples having viable bacteria would increase to 87.5 percent and 71.8 percent, respectively.

Sealant effectiveness: S. mutans and lactobacilli. Three studies provided data for mean and median S. mutans VBC counts (seven observations representing 130 samples with follow-up times ranging from one day to five years; data not shown). Two of the three studies showed a twofold reduction in the log_{10} mean S. mutans VBC at the last sampling period. In one of these two studies, however, the median count was 0 for both sealed and unsealed teeth. The other study, the only one to test for statistical significance, showed that the reduction was indeed significant. In the third study, the reduction in the log_{10} median S. mutans VBC was −0.45; it should be noted that in this study, the VBC were very low at baseline (< 1 × 10^3) and at follow-up (< 6 × 10^3), so any difference likely represented normal microbiological sampling variability. Two studies presented data on the percentage of samples with S. mutans. In one study, sealants reduced the probability of viable S. mutans by 63 percent, and in the study with very low S. mutans counts at baseline, sealants increased the probability of viable S. mutans by 38 percent.

Two studies provided data on lactobacilli counts (two observations across time representing 68 samples; data not shown). The reduction in log_{10} mean and median VBC was 1.75. The reduction was significant in the one study that tested for statistical significance. In both studies, the
### TABLE 1

**Description of included studies.**

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>STUDY AUTHOR, YEAR, SITE AND DURATION (MONTHS)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subjects’ Age (Years) and Background Community Fluoridation Exposure</strong></td>
<td>Going and Colleagues,14 1975, United States, 60</td>
</tr>
<tr>
<td>10 to 14; no fluoridation</td>
<td>12 to 15; study location was fluoridated</td>
</tr>
<tr>
<td><strong>Lesion and Sealant Method by which cavitation status was assessed at baseline</strong></td>
<td>Visual-tactile (VT) examination</td>
</tr>
<tr>
<td><strong>Lesion classification</strong></td>
<td>Enamel (explorer catch) or dentinal (explorer stick/penetration)</td>
</tr>
<tr>
<td><strong>Material used</strong></td>
<td>RB1</td>
</tr>
<tr>
<td><strong>Retention rate (%)</strong></td>
<td>100†</td>
</tr>
<tr>
<td><strong>Study Design</strong></td>
<td>51</td>
</tr>
<tr>
<td><strong>No. of subjects at baseline</strong></td>
<td>Non-RCT</td>
</tr>
<tr>
<td><strong>No. of teeth</strong></td>
<td>NR</td>
</tr>
<tr>
<td><strong>Dropout (DO) rate for teeth</strong></td>
<td>27% across 5 years</td>
</tr>
<tr>
<td><strong>Examiner blinding</strong></td>
<td>Yes#</td>
</tr>
<tr>
<td><strong>Laboratory Methods</strong></td>
<td>100</td>
</tr>
<tr>
<td><strong>No. of samples</strong></td>
<td>80</td>
</tr>
<tr>
<td><strong>Isolation</strong></td>
<td>NR</td>
</tr>
<tr>
<td><strong>Site sterilization</strong></td>
<td>Rubber dam</td>
</tr>
<tr>
<td><strong>Betadine solution followed by 70% isopropyl alcohol</strong></td>
<td>Rubber dam</td>
</tr>
<tr>
<td><strong>Sample size</strong></td>
<td>0.1 milliliter of culture to plate</td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td>Todd Hewitt agar, blood agar, and nitrocellulose agar</td>
</tr>
<tr>
<td><strong>Culture time</strong></td>
<td>3 to 4 days</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td>CFU/mg (plate)††</td>
</tr>
</tbody>
</table>

* The researchers were located in Augusta, Ga., which had a fluoridated water supply at the time the study was conducted.
‡ Findings for Epoxylight 9075 (Lee Pharmaceuticals, South El Monte, Calif.) and 3M Caries Preventive Treatment (3M, now 3M ESPE, St. Paul, Minn.) excluded because two-week retention was less than 50 percent. For 3M product, acid concentration for etching was below recommended norm.
§ Study states that researchers verified integrity of sealant at each examination period (three, six, 12, 24, 36, 48 and 60 months).
¶ Study had 13 subjects and 24 teeth. We excluded findings for seven resealed teeth because the baseline bacteria levels were lower than those in never-sealed teeth.
# All bacteriologic samples were processed and interpreted without knowledge of which treatment group was involved or of the clinical findings.
** The researchers attempted to obtain representative samples for all teeth; thus, for slight caries penetration they sampled almost the entire lesion, and for deep lesions they sampled both superficial and deeper layers.
†† CFU/mg: Colony-forming units per milligram.
‡‡ Cloudiness in liquid culture indicates bacterial activity.

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TABLE 2

The effect of sealants on mean total viable bacteria count (MTVBC*) per milligram of carious dentin, by months since placement.

<table>
<thead>
<tr>
<th>STUDY</th>
<th>MONTHS SINCE SEALANT PLACEMENT</th>
<th>SEALED CARIES</th>
<th>CONTROL</th>
<th>EFFECT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Bacterial Samples</td>
<td>MTVBC</td>
<td>No. of Bacterial Samples</td>
<td>MTVBC</td>
</tr>
<tr>
<td>*Power represents inverse of dilution ratio; that is, a power of 4 indicated dilution ratio was 1:4.†Samples from nine teeth obtained at baseline served as the control group in all follow-up periods.‡ Twenty-nine samples obtained at baseline served as the control group in all follow-up periods.§ NR: Not reported.¶ Median value per 0.2 milligrams of carious dentin.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jensen and Handelman</td>
<td>0.03</td>
<td>11</td>
<td>455.6 × 10⁴</td>
<td>9†</td>
</tr>
<tr>
<td>Jensen and Handelman</td>
<td>0.10</td>
<td>8</td>
<td>320.8 × 10⁴</td>
<td>9</td>
</tr>
<tr>
<td>Jensen and Handelman</td>
<td>0.23</td>
<td>10</td>
<td>120.6 × 10⁴</td>
<td>9</td>
</tr>
<tr>
<td>Handelman and Colleagues</td>
<td>0.35</td>
<td>8</td>
<td>5.0 × 10⁴</td>
<td>29‡</td>
</tr>
<tr>
<td>Jensen and Handelman</td>
<td>0.5</td>
<td>12</td>
<td>35.9 × 10⁴</td>
<td>9</td>
</tr>
<tr>
<td>Handelman and Colleagues</td>
<td>1</td>
<td>10</td>
<td>4.7 × 10⁴</td>
<td>29</td>
</tr>
<tr>
<td>Jensen and Handelman</td>
<td>1</td>
<td>12</td>
<td>12.1 × 10⁴</td>
<td>9</td>
</tr>
<tr>
<td>Handelman and Colleagues</td>
<td>2</td>
<td>10</td>
<td>2.9 × 10⁴</td>
<td>29</td>
</tr>
<tr>
<td>Jensen and Handelman</td>
<td>2</td>
<td>8</td>
<td>154.5 × 10⁴</td>
<td>9</td>
</tr>
<tr>
<td>Handelman and Colleagues</td>
<td>4</td>
<td>6</td>
<td>1.0 × 10⁴</td>
<td>29</td>
</tr>
<tr>
<td>Jensen and Handelman</td>
<td>4</td>
<td>10</td>
<td>6.7 × 10⁴</td>
<td>9</td>
</tr>
<tr>
<td>Handelman and Colleagues</td>
<td>6</td>
<td>8</td>
<td>0.6 × 10⁴</td>
<td>29</td>
</tr>
<tr>
<td>Jensen and Handelman</td>
<td>6</td>
<td>8</td>
<td>7.5 × 10⁴</td>
<td>9</td>
</tr>
<tr>
<td>Weerheijm and Colleagues</td>
<td>7</td>
<td>17</td>
<td>1.5 × 10⁵</td>
<td>17</td>
</tr>
<tr>
<td>Handelman and Colleagues</td>
<td>12</td>
<td>12</td>
<td>0.1 × 10⁴</td>
<td>29</td>
</tr>
<tr>
<td>Jensen and Handelman</td>
<td>12</td>
<td>9</td>
<td>0.9 × 10⁴</td>
<td>9</td>
</tr>
<tr>
<td>Handelman and Colleagues</td>
<td>24</td>
<td>6</td>
<td>0.1 × 10⁴</td>
<td>29</td>
</tr>
<tr>
<td>Going and Colleagues</td>
<td>60</td>
<td>30</td>
<td>25.6 × 10³</td>
<td>21</td>
</tr>
<tr>
<td>Mean (Last Follow-Up)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (Last Follow-Up)</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
percentage of samples with lactobacilli was lower for sealed teeth than for unsealed teeth. The percentage reduction in probability of viable lactobacilli was 37 percent.

**DISCUSSION**

Sealants were effective in reducing total bacteria counts in caries lesions. The reduction increased with time since sealant placement. At the last follow-up, there was a 100-fold decrease in mean bacteria counts in two studies\(^{14,19}\) and a 1,000-fold decrease in the remaining two studies.\(^{15,16}\) Sealants also reduced bacterial cultivability. On average, 47 percent of sealed lesions had viable bacteria (median = 50 percent) compared with 89 percent of unsealed lesions (median = 100 percent). When we excluded deep dentinal lesions, these values decreased to 27 percent for sealed lesions (median = 8 percent) and 83 percent in unsealed lesions (median = 83 percent) (Table 3).

### TABLE 3

<table>
<thead>
<tr>
<th>STUDY</th>
<th>MONTHS SINCE PLACEMENT</th>
<th>SEALED LESIONS</th>
<th>UNSEALED LESIONS</th>
<th>% REDUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No.</td>
<td>No.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>With &gt; 0 CFUs*</td>
<td>With &gt; 0 CFUs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>No.</td>
<td>No.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jeronimus and Colleagues(^{17}) (I)</td>
<td>0.5</td>
<td>6</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>Jeronimus and Colleagues (I)</td>
<td>0.75</td>
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</tr>
<tr>
<td>Jeronimus and Colleagues (I)</td>
<td>1</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weerheijm and Colleagues(^{18})</td>
<td>7</td>
<td>17</td>
<td>16</td>
<td>94</td>
</tr>
<tr>
<td>Mertz-Fairhurst and Colleagues(^{18})</td>
<td>12</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Going and Colleagues(^{19,21})</td>
<td>60</td>
<td>30</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>Jeronimus and Colleagues (MD(^{1}))</td>
<td>0.5</td>
<td>5</td>
<td>5</td>
<td>100</td>
</tr>
<tr>
<td>Jeronimus and Colleagues (MD)</td>
<td>0.75</td>
<td>4</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>Jeronimus and Colleagues (MD)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>67</td>
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<tr>
<td>Median (All Studies, All Observations)</td>
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<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (All Studies, Excluding Jeronimus MD)</td>
<td></td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (All Studies, All Observations)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (All Studies, Excluding Jeronimus MD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* CFUs: Colony-forming units.
† I: Incipient dentinal caries, no more than one-quarter of the distance between the dentinoenamel junction and pulp.
‡ Samples obtained from six teeth at baseline served as controls in all follow-up periods.
§ Bacterial samples obtained before sealant placement served as the control group; bacterial samples obtained from the same teeth seven months after sealant placement served as the treatment group.
¶ Minimum level of detection in study was 50 organisms per sample.
# MD: moderate-to-deep dentinal caries, more than one-half the distance between the dentinoenamel junction and the pulp.
** Samples obtained from five teeth at baseline served as controls in all follow-up periods.
These data suggest that a limited number of culturable organisms may persist in some lesions but that their numbers are small. The effect of sealants on levels of *S. mutans* and lactobacilli, which have been suggested as primary cariogens in pit-and-fissure caries, also was strong in two of the three studies that examined this outcome. These results provide more specific information about the preventive effects of sealants at the surface level.

Bacterial activity, as measured by a reduction in log mean VBC or the percentage of culturable samples, decreased with time in all studies that had multiple follow-up periods. Results of one study showed a linear decrease in mean log$_{10}$ VBC across time. Since bacteria decreased across time, the findings of this review suggest that retained sealants deprive bacteria of access to nutrients in the substrate. Furthermore, it appears that bacteria that persist under sealants cannot produce acid when isolated from the carbohydrate substrate and, thus, adequately sealed lesions are unlikely to progress. Another analysis of studies included in the larger systematic review that supported this report on bacteria levels under sealants found that sealing noncavitated lesions reduced the probability of lesion progression by more than 70 percent.

The importance of adequately sealing a carious lesion is further supported by the finding that retained sealants regardless of material were effective. Studies included in this review used a variety of sealant materials: RBS polymerized by visible or ultraviolet light, autopolymerized RBS and GIC. Of the six studies that used RBS, five reported retention rates, and in these studies, retention was 100 percent. For the one study that also used GIC, full retention was 0 percent, but in all lesions, the opening remained sealed at follow-up. Because the opening remained sealed, we cannot determine if the effectiveness of GIC was attributable to the isolation of bacteria from nutrients in the substrate, the release of fluoride into the dentin or a combination of both factors. It is hypothesized that release of fluoride from GIC contributes to primary caries prevention. However, the clinical effect of fluoride release from GIC is not well-established; a systematic review showed insufficient evidence to recommend GIC for the primary prevention of dental caries. Interestingly, one study reported that fissures with caries retained sealants better than did apparently intact fissures.

The larger systematic review found two additional studies providing evidence that sealants are effective in reducing bacteria viability. The first study, which was published in 1943, examined bacteria levels in caries sealed with base-plate gutta-percha packed down tightly and then in turn covered by zinc oxyphosphate cement. Results from this study showed that lactobacilli died out in all cases between two and 10 months after sealing and that streptococcus test results remained positive in more than one-third of the teeth studied after having been sealed for more than one year. Another study, an RCT, compared sealing bacteria in carious dentin with GIC restorative material with sealing bacteria with amalgam. This study found that at six months, both materials inhibited caries progression as measured by total counts of bacteria, *S. mutans* and lactobacilli but that a larger decrease in *S. mutans* and lactobacilli resulted from GIC use.

Other studies document that at least two other species of bacteria can persist even when deprived of nutrients. These species enter a starvation state, which allows bacterial long-term persistence in a nongrowing but cultivable state for at least two months. Further research is needed to determine how long cariogenic bacteria can persist when isolated from nutrients. The longest period for studies included in this review was five years; however, current data suggest that a sizable number of sealants are retained for almost twice that time. One additional argument for the effectiveness of sealants in reducing bacterial activity is the fact that fissures in sound teeth harbor cariogenic bacteria and that, because these sealed teeth remain caries-free in most instances, these sealed-over bacteria either perish or are no longer metabolically active. Study results indicate that some teeth still have a considerable number of bacteria remaining even after acid etching.

One limitation of this review was that all included studies were conducted before 2000. The sole criterion for bacterial viability in these studies was cultivability. Since that time, microbiological quantification and characterization have become DNA-based, obviating the need for cultivation, which captures only the cultivable minority of microorganisms present. Another limitation was that one outcome measure reported in four studies, mean VBC, is sensitive to outlying values. As a result, mean VBC typically are transformed to log$_{10}$ values, and the
mean then is calculated for these transformed values. However, investigators in two of the three studies that found that mean VBC were lower in sealed teeth performed their statistical testing on transformed values.\textsuperscript{12,13} Further research is needed with studies that meet current standards in design and conduct.

Our findings do not support reported concerns about poorer outcomes associated with inadvertently sealing caries and should lessen practitioners’ reluctance to provide sealants—an intervention proven to be highly effective in preventing caries. Indeed, although study conduct varied considerably, there were no findings of significant increases in bacteria under sealants.

\textbf{CONCLUSION}

We found that sealants significantly reduced bacteria levels in cavitated lesions, but that in some studies, low levels of bacteria persisted. These findings support those of a recent meta-analysis that sealants prevented caries progression.\textsuperscript{12} In combination, these two sets of findings suggest that when sealants are retained, and thus access to fermentable substrates is blocked, bacteria do not appear capable of exerting their cariogenic potential.

\textbf{Disclosure:} None of the authors reported any disclosures.

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the U.S. Centers for Disease Control and Prevention, Atlanta.

The authors gratefully acknowledge the generous contribution of time and expertise by the U.S. Centers for Disease Control and Prevention's Dental Sealant Systematic Review Work Group: James D. Bader, DDS, MPH; Jane A. Weintraub, DDS, MPH; and-fissure sealants. Caries Res 1993;27(suppl 1):77-82.


A comparison of the effects of toothbrushing and handpiece prophylaxis on retention of sealants

Shellie Kolavic Gray, DMD, MPH; Susan O. Griffin, PhD; Dolores M. Malvitz, DrPH; Barbara F. Gooch, DMD, MPH

In the placement of pit-and-fissure sealants, a clean tooth surface facilitates direct contact between acid etchant and enamel. The etched enamel, in turn, provides microporosities into which resin-based material flows to form a mechanical bond that retains the sealant against the tooth surface. Pumice prophylaxis by means of a rubber cup or rotary brush on a slow-speed handpiece has been a method commonly used for surface cleaning before acid etching. Other methods, however, have been used in clinical care settings and school programs. For example, in 2001, 45 and 15 percent of pediatric dentists reported using pumice or paste and a rotary cup or brush, respectively, for surface cleaning teeth during sealant placement. Thirteen percent reported using a toothbrush, and 11 percent reported using nothing, which we presume was with the use of the air-water syringe. Toothbrush prophylaxis commonly is used in school-based dental sealant (SBDS) programs to clean the tooth before etching the enamel surface.

Recent evidence-based clinical recommendations for use of pit-and-fissure sealants did not specifically address surface-cleaning methods, which can have a significant impact on sealant retention. A study was conducted to compare the effects of handpiece and toothbrush prophylaxis on sealant retention.

**Background.** Tooth surface cleaning before acid etching is considered to be an important step in the retention of resin-based pit-and-fissure sealants.

**Methods.** The authors reviewed and summarized instructions for cleaning tooth surfaces from five manufacturers of 10 unfilled resin-based sealants marketed in the United States. The authors also searched electronic databases for studies that directly compared the effects of different surface-cleaning methods on sealant retention and for systematic reviews of the effectiveness of sealants. They explored the association between surface-cleaning methods and sealant retention in the studies included in the systematic reviews. They calculated the summary weighted retention rates for studies that used either a handpiece or toothbrush prophylaxis.

**Results.** All of the sealant manufacturers’ instructions for use (IFU) recommended cleaning the tooth before acid etching. None of the IFU directly stated that a handpiece was required to perform the cleaning, but five IFU implied the use of handpiece prophylaxis. None of the IFU recommended surface-altering procedures in caries-free teeth. Direct evidence from two clinical trials showed no difference in complete sealant retention between surfaces cleaned mechanically with pumice or prophylaxis paste and those cleaned with air-water syringe or dry toothbrushing. Indirect evidence from 10 studies found that weighted summary retention by year after sealant placement in studies that used toothbrush prophylaxis was greater than or equivalent to values for studies that used handpiece prophylaxis.

**Conclusions.** Levels of sealant retention after surface cleaning with toothbrush prophylaxis were at least as high as those associated with handpiece prophylaxis.

**Clinical Implications.** This finding may translate into lower resource costs for sealant placement.

**Key Words.** Dental sealants; pit-and-fissure sealants; acid etching; dental prophylaxis; toothbrush cleaning; dental cleaning.

although supporting information acknowledged that manufacturers’ sealant placement instructions should be consulted and that a surface-cleaning step typically is included in these instructions. Concurrent with the development of clinical recommendations by the American Dental Association, the Centers for Disease Control and Prevention (CDC) convened a work group of experts to examine the available information and update recommendations related to specific practices in SBDS programs. SBDS programs typically are found in schools that serve children from low-income families, and they focus primarily on sealing occlusal surfaces of permanent molars—the teeth that are most susceptible to dental caries. As part of the CDC’s review, the work group considered the effectiveness of placement techniques, such as surface-cleaning methods and manufacturers’ instructions for use (IFU).

In this article, we describe surface-cleaning methods recommended by manufacturers for unfilled resin-based sealants before acid etching, as well as the findings of clinical studies that compared sealant retention by surface-cleaning methods. Because there are few clinical studies that directly compare surface-cleaning methods and sealant outcomes, we also examined studies included in systematic reviews of sealant effectiveness. These studies typically contain detailed descriptions of surface-cleaning and placement procedures and provide indirect evidence about the association between cleaning methods and sealant outcomes.

**METHODS**

We reviewed and summarized surface-cleaning methods detailed in IFU for unfilled sealant materials marketed in the United States by five manufacturers. We focused our review of IFU on unfilled sealants because they do not require occlusal adjustment and, thus, are used most commonly in school programs.

We searched electronic databases for clinical studies published in English during the period of 1966 through 2006 that directly compared results for the retention or effectiveness of resin-based sealants after different surface-cleaning procedures. For our search of the PubMed database, we used the following search strategy: “Pit and Fissure Sealants”[Mesh] AND (cleaning[Text Word] OR prophylaxis[Text Word]) AND (“humans”[MeSH Terms] AND English[Lang]) AND (Clinical Trial[ptyp] OR Randomized Controlled Trial[ptyp])). We used similar parameters when we searched The Cochrane Library database. The searches yielded 25 articles representing 21 unique studies. Two of the authors (S.K.G. and S.O.G.) screened titles and abstracts and excluded 19 of the 21 studies because they were not about resin-based sealants or did not directly compare the cleaning methods used before placement. One author (S.K.G.) abstracted the two remaining studies.

Because our literature review yielded only two comparative clinical studies, we also searched the literature for systematic reviews of the effectiveness of sealants. From the studies included in these reviews, we documented surface-cleaning methods and sealant outcomes and, thus, generated indirect evidence about the relationship between surface-cleaning methods and sealant retention. We searched PubMed and The Cochrane Library for reviews that were published in English between 1990 and 2006. We identified four systematic reviews, which included 35 unique studies. One author (S.K.G.) screened these studies and excluded 24 of the 35 studies for the following reasons: was not published in English, had no concurrent comparison group, involved the use of ultraviolet light–polymerized resin-based sealant material (that is, first-generation material), contained insufficient information to estimate both the percentage of sealants that were fully retained on permanent first molars by year since placement and the standard errors (SE) of those estimates, involved the use of mechanical preparation such as enameloplasty or fissureotomy before sealant placement, or involved the repair or reapplication of lost or fractured sealant material.

For 11 of the 35 studies that met our inclusion criteria, one author (S.K.G.) documented the study designs, methods of cleaning and preparing the surface, retention of the sealant over time and other descriptive data. If adequate detail about surface-cleaning methods was not provided, we contacted the study’s authors to verify information about how they conducted the study.

The main outcome measure in our analysis of indirect evidence was the percentage of sealants fully retained on the occlusal pits and fissures of permanent first molars. NR: Not reported. SBDS: School-based dental sealant.

first permanent molars at annual follow-up examinations. We chose retention instead of effectiveness as the outcome because retention would be less affected by potential confounders such as differences in caries risk among the sample populations of multiple studies. We assumed a binomial distribution in calculating the SE of the retention rate:

\[
\text{SE} = \sqrt{\frac{\text{retention} \times (1 - \text{retention})}{n}}
\]

For each of the five years after sealant placement, we calculated a summary retention rate separately for the studies that used the same type of surface-cleaning method (for example, handpiece or toothbrush prophylaxis). We weighted the studies by the reciprocal of their squared SE. We deemed summary retention rates by cleaning method significantly different if the 95 percent confidence intervals (rounded up to two decimal points) did not overlap.

RESULTS

Manufacturers’ IFU. We identified 10 unfilled sealant products from five manufacturers. The IFU for all 10 products directed the operator to clean the tooth surface before acid etching (Table 1). In Table 1, each manufacturer is designated by a letter, and the unfilled sealant products manufactured by the same company are numbered. For example, A-1, A-2 and A-3 are three unfilled sealants from the same manufacturer. None of the IFU directly stated that a handpiece was required to perform the cleaning. However, the use of pumice, prophylaxis paste or prophylaxis brush was included in the IFU for five products, implying handpiece use. Language in the IFU for the other five products was nonspecific. The IFU for seven products indicated that use of fluoride-containing or oil-containing pastes be avoided. None of the IFU specifically directed the operator to perform enameloplasty, fissureotomy, air abrasion or air polishing to clean the tooth surface before placing the sealant. The IFU for one product, however, directed the operator to remove minimal caries with a small round bur in a slow-speed handpiece after surface cleaning.

Direct evidence. From the literature search, we identified two clinical trials that directly compared surface-cleaning methods.\textsuperscript{5,31} Investigators in these studies found no difference in complete retention of sealants between surfaces that were cleaned mechanically with pumice and those that were cleaned by means of an air-water spray and running a sharp probe along the fissures. Both studies reported retention rates greater than 96 percent at one year after placement for all surface-cleaning methods (Table 2, page 42).

Indirect evidence. Eleven of 35 studies from four systematic reviews of the effectiveness of sealants met our initial criteria.\textsuperscript{6,7,9,47} We were unable to determine definitively the surface-cleaning method used in one study\textsuperscript{68} and excluded the study from our analysis. Handpiece prophylaxis with a rubber cup or rotary brush was used in eight studies, and toothbrush prophylaxis was used in two studies (Table 3, page 43). Of those studies using handpiece prophylaxis, four used pumice and four used prophylaxis paste. Of the latter four studies, three specifically stated that the paste did not contain fluoride, and one did not specify if the paste contained fluoride. Only one of the four studies using prophylaxis paste indicated that the paste was oil-free.\textsuperscript{61} No studies stated if there was fluoride or oil in the pumice. Of the two studies using toothbrush prophylaxis, patients (under the supervision of an operator) brushed their own teeth—in one study with fluoride-containing toothpaste, and in the other with a dentifrice without fluoride. We observed no difference in reported retention of sealants between these two studies (Table 4, page 44).

From the 10 selected studies, we generated weighted summary measures of complete retention (percentage) for sealants (Table 4). Because of notably low retention rates for one operator in a study that used handpiece prophylaxis,\textsuperscript{65} we excluded that operator’s results. By not including the findings from this operator, our findings were biased toward handpiece prophylaxis being more effective. Weighted summary retention by year after sealant placement for studies that used toothbrush prophylaxis was either greater than or equivalent to values for studies that used handpiece prophylaxis (Table 4). The summary retention rate for studies using toothbrush prophylaxis was higher at year one compared with studies using handpiece prophylaxis, and we observed no differences in summary retention between the two cleaning methods at years two through five (Table 4).

DISCUSSION

We found that the five manufacturers of the unfilled resin-based sealants marketed in the United States that we included in our review
instructed the operator to clean the surface before performing acid etching and placing the sealant material. IFU for five of the products included in our limited review did not specify a particular cleaning method, thus allowing operators to use their professional judgment. Some IFU stated that additives, such as fluoride or oil, should be avoided. In 1982, Gwinnett noted that there were no studies that contraindicated the use of fluoride-containing prophylaxis paste for cleaning the tooth surface before etching. Recommendations in sealants’ IFU to avoid fluoride might be based on older in vitro or laboratory studies that found exposure of enamel to topical fluorides inhibited acid etching and reduced the bond strength of early sealant products. More recent clinical and in vitro studies suggest that exposure of teeth to various topical fluoride treatments or fluoride-containing prophylaxis paste before sealant placement does not decrease retention or bond strength. Similarly, we found no difference in sealant retention between two studies that used toothpaste with and without fluoride before sealant placement.

In our literature search, we found only two published clinical studies that directly compared sealant retention by surface-cleaning methods, but our findings are consistent with those of a recent systematic review of retention of resin-based sealants, which was published after we began our analysis. The systematic review also reported no difference for the study by Donnan and Ball, which compared handpiece cleaning to no cleaning beyond an air-water spray and running a sharp probe along the fissures, and for the study by Gillcrist and colleagues, which compared handpiece cleaning (with fluoride-containing paste) to dry toothbrush cleaning provided by the operator.

Although the studies that we evaluated from systematic reviews did not directly compare surface-cleaning methods, they provided suf-

### TABLE 1

<table>
<thead>
<tr>
<th>MANUFACTURER-PRODUCT</th>
<th>CLEANING IMPLEMENT</th>
<th>CLEANING MATERIAL</th>
<th>CLEANING METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>Prophylaxis brush</td>
<td>Pumice and water, no commercial prophylaxis pastes (fluoride or oil additives interfere with etching)</td>
<td>Handpiece not specifically stated in IFU but implied through recommended use of prophylaxis brush</td>
</tr>
<tr>
<td>A-2</td>
<td>Prophylaxis brush</td>
<td>Pumice and water, no commercial prophylaxis pastes (fluoride or oil additives interfere with etching)</td>
<td>Handpiece not specifically stated in IFU but implied through recommended use of prophylaxis brush</td>
</tr>
<tr>
<td>A-3</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Nonspecific; IFU do not state or imply use of handpiece or prophylaxis paste</td>
</tr>
<tr>
<td>B-1</td>
<td>Not stated</td>
<td>Prophylaxis paste (nonfluoride, oil-free) or pumice and water</td>
<td>Handpiece not specifically stated in IFU but implied through recommended use of prophylaxis and prophylaxis paste</td>
</tr>
<tr>
<td>B-2</td>
<td>Not stated</td>
<td>Prophylaxis paste (nonfluoride, oil-free) or pumice and water</td>
<td>Handpiece not specifically stated in IFU but implied through recommended use of prophylaxis and prophylaxis paste</td>
</tr>
<tr>
<td>C-1</td>
<td>Not stated</td>
<td>Paste (nonfluoride, oil-free)</td>
<td>Nonspecific; IFU do not state or imply use of handpiece and description of paste is nonspecific</td>
</tr>
<tr>
<td>C-2</td>
<td>Not stated</td>
<td>Paste (nonfluoride oil-free)</td>
<td>Nonspecific; IFU do not state or imply use of handpiece and description of paste is nonspecific</td>
</tr>
<tr>
<td>D-1</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Nonspecific; IFU do not state or imply use of handpiece or prophylaxis paste</td>
</tr>
<tr>
<td>D-2</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Nonspecific; IFU do not state or imply use of handpiece or prophylaxis paste</td>
</tr>
<tr>
<td>E-1</td>
<td>Not stated</td>
<td>Prophylaxis paste (nonfluoride oil-free)</td>
<td>Handpiece not specifically stated in IFU but implied through recommended use of prophylaxis paste; minimal caries removed with small round bur in slow speed handpiece</td>
</tr>
</tbody>
</table>

* Instructions for use.
sufficiently detailed information about cleaning methods and retention to allow us to conduct a weighted bivariate analysis. Based on the summary retention data we examined, it appears that sealant retention was the same or higher when teeth were cleaned with a toothbrush rather than with a handpiece. For this group of studies that we included in our review, we found that sealant retention was higher in studies using toothbrush prophylaxis at one year. In years two through five, however, toothbrush and handpiece cleaning had similar percentages of sealant retention. We excluded one study from our analysis because the surface-cleaning method was not specifically described. The article stated that tooth surfaces “received careful mechanical cleaning,” a phrase that may suggest the use of a handpiece. When we included the findings from this study in our analysis along with the other studies using handpiece prophylaxis, we found that the summary retention was higher in studies using toothbrush prophylaxis at both year one and year two. Retention data for the excluded study were not reported after two years; therefore, our summary retention did not change for years three through five.

Toothbrushing differs from other cleaning methods—such as handpiece prophylaxis, air-polishing or use of an explorer—because either the patient or the provider can do it. In our literature review, we did not identify any studies that compared sealant retention when the operator brushed the patient’s teeth versus when the patient brushed his or her own teeth. In both studies that we included in our indirect analysis to generate summary retention findings, a toothbrush was used to clean the surface. Patients (that is, children) brushed their teeth with a dentifrice while supervised by an operator. Summary retention data reported in our study for both handpiece and toothbrush cleaning (for example, 85 percent or higher at one year) are consistent with estimates of sealant retention reported in comprehensive reviews of the literature. In addition, toothbrushing can be performed with or without toothpaste or other dentifrice. Retention data at one year for toothbrushing with toothpaste was similar to reported retention for dry toothbrushing in the clinical study by Gillcrist and colleagues; summary retention was higher than 94 percent for both methods.

The surface-cleaning method also was included in a recent multivariate analysis exploring four-handed delivery and retention of resin-based sealants. In that analysis, Griffin and colleagues found that retention was lower when surfaces were cleaned with a handpiece before placement. It is possible that some prophylaxis pastes marketed in the 1970s and 1980s contained oils or other substances that interfered with bonding. It also is possible that residual paste or pumice within pits and fissures after prophylaxis and etching could reduce retention of sealants.

Consistent with general manufacturers’ IFU, all studies included in our analyses cleaned the tooth surface before acid etching, either with a handpiece, toothbrush or air-water spray. In the earliest sealant studies, Buonocore and colleagues and Cueto and Buonocore used a pumice handpiece prophylaxis to provide a clean enamel surface for etching. Donnan and Ball suggested that the scientific justification for the handpiece prophylaxis before acid etching may rest on a study by Miura and colleagues. The latter study reported that pumice prophylaxis improved bond strength for orthodontic brackets on smooth surfaces of premolars that were subsequently extracted and evaluated via scanning electron microscope. The authors concluded that the “greatest adhesion was achieved when both polishing and acid etching were carried out.” The relevance of these findings to application of sealants to occlusal pits and fissures is unclear, however, because the materials and methods used in that study—use of 70 percent ethyl alcohol before and after prophylaxis, application of a

<table>
<thead>
<tr>
<th>STUDY</th>
<th>SURFACE-CLEANING METHOD</th>
<th>RETENTION RATE (%)</th>
<th>6 Months</th>
<th>12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gillcrist and Colleagues</td>
<td>Handpiece, prophylaxis brush, fluoride prophylaxis paste</td>
<td>NR*</td>
<td>97.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dry toothbrushing by operator</td>
<td>NR</td>
<td>99.2</td>
<td></td>
</tr>
<tr>
<td>Donnan and Ball</td>
<td>Handpiece, prophylaxis brush, pumice</td>
<td>98.3</td>
<td>96.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sharp probe along fissures, forceful water spray</td>
<td>98.3</td>
<td>97.3</td>
<td></td>
</tr>
</tbody>
</table>

* NR: Not reported.
silane coupling agent and placement of sealant material on smooth surfaces—are not common elements of pit-and-fissure sealant placement.

Our study had some limitations. In our review of the literature, we found only two direct comparative studies of surface cleaning methods. In our analysis of studies included in systematic reviews of effectiveness, we found only two

<table>
<thead>
<tr>
<th>TABLE 3</th>
<th>Cleaning method descriptions and summary measures of resin-based sealant retention, by study.</th>
</tr>
</thead>
<tbody>
<tr>
<td>STUDY</td>
<td>YEAR STUDY BEGAN</td>
</tr>
<tr>
<td>Charbonneau and Dennison 1975</td>
<td>5-8</td>
</tr>
<tr>
<td>Erdogan and Alaçam 1982</td>
<td>8-10</td>
</tr>
<tr>
<td>Gibson and Colleagues 1975</td>
<td>6-10</td>
</tr>
<tr>
<td>Houpt and Shey 1976</td>
<td>6-10</td>
</tr>
<tr>
<td>Hunter 1973</td>
<td>NR²</td>
</tr>
<tr>
<td>McCune and Colleagues 1975</td>
<td>6-9</td>
</tr>
<tr>
<td>Mertz-Fairhurst and Colleagues 1975</td>
<td>6-8</td>
</tr>
<tr>
<td>Poulsen and Colleagues 1995</td>
<td>7</td>
</tr>
<tr>
<td>Rock and Bradnock (Opalfor 2) 1974</td>
<td>6-7</td>
</tr>
<tr>
<td>Vrbič 1979</td>
<td>6.8</td>
</tr>
</tbody>
</table>

* Studies may have included other age groups, but we limited our review to 5- to 10-year-olds.
† M1: Permanent first molars. Studies may have examined primary teeth or other permanent teeth, but we limited our analysis to permanent first molars.
‡ NR: Not reported.
§ First-generation sealant on one side of mouth and second-generation sealant on the other one-half. Values for first-generation sealant not included in table.
studies that used toothbrush prophylaxis. Our analysis of studies from systematic reviews was observational and limited to bivariate analysis. Our findings may be subject to recall bias because we contacted authors to obtain additional information if adequate data were not included in their studies. Because the studies in the systematic reviews were not designed to compare sealant outcomes by surface-cleaning method directly, the association between retention and an explanatory variable might have been due to another variable that was omitted. Although the possibility of confounding remains, a recent multivariate analysis found that toothbrush prophylaxis was associated with higher sealant retention than was handpiece prophylaxis.81

We limited our search for indirect evidence to studies in the existing systematic reviews of sealant effectiveness.32-35 These studies already had met specific rules for study design, conduct and measurement established for each systematic review. In the absence of published comparative studies, our less resource-intensive method to identify and screen potential studies is attractive because it is an efficient method of collecting data from well-conducted studies. We minimized bias because the authors of the original systematic reviews determined the universe of studies. Although only one author screened these studies for our review, the inclusion and exclusion criteria in our analysis were objective and were specified before we screened available studies.

**CONCLUSIONS**
The results of our comparative tooth cleaning analysis indicate that retention of sealants after a supervised toothbrush cleaning by the patient was at least as high as those associated with a traditional handpiece prophylaxis. Our findings may translate into lower costs for materials, equipment and personnel.

**Disclosure.** None of the authors reported any disclosures.

The findings and conclusions of this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.


---

**TABLE 4**

<table>
<thead>
<tr>
<th>STUDY</th>
<th>COMPLETE RETENTION (% [95% CONFIDENCE INTERVAL])</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year One</td>
</tr>
<tr>
<td>Toothbrush Prophylaxis</td>
<td></td>
</tr>
<tr>
<td>Houp and Shey6</td>
<td>94 (91-97)</td>
</tr>
<tr>
<td>Mertz-Fairhurst and colleagues7</td>
<td>95 (92-97)</td>
</tr>
<tr>
<td>SUMMARY RETENTION</td>
<td>94 (92-96)</td>
</tr>
<tr>
<td>Handpiece Prophylaxis</td>
<td></td>
</tr>
<tr>
<td>Charbeneau and Dennison49</td>
<td>79 (74-85)</td>
</tr>
<tr>
<td>Erdogan and Alaçam60</td>
<td>77 (70-85)</td>
</tr>
<tr>
<td>Gibson and colleagues61</td>
<td>90 (87-93)</td>
</tr>
<tr>
<td>Hunter62</td>
<td>NR</td>
</tr>
<tr>
<td>McCune and colleagues63</td>
<td>92 (88-95)</td>
</tr>
<tr>
<td>Poulson and colleagues64</td>
<td>NR</td>
</tr>
<tr>
<td>Rock and Bradnock65 (Operator 2†)</td>
<td>75 (67-82)</td>
</tr>
<tr>
<td>Vrbic67</td>
<td>NR</td>
</tr>
<tr>
<td>SUMMARY RETENTION</td>
<td>87 (85-89)</td>
</tr>
</tbody>
</table>

* NR: Not reported.
† Results from operator 1 excluded, owing to notably low results.
Almost 70 percent of youth have experienced dental caries by late adolescence. Available data show that children and youth from low-income families (those with an income of less than 200 percent of the federal poverty guidelines) are more than twice as likely to have untreated caries in their permanent teeth as are their higher-income counterparts. Overall, about 90 percent of carious lesions are found in the pits and fissures of permanent posterior teeth, with molars being the most susceptible to caries in comparison with other tooth types.

Researchers have shown that dental sealants delivered in clinical or school settings are highly effective in preventing dental caries, reducing caries in the pits and fissures by 60 percent from two to five years after placement. Sealant effectiveness is linked to sealant retention, and a retained sealant has been shown to be 100 percent effective. Although systematic reviews have demonstrated the effectiveness of dental sealants, recent national data indicate that sealant prevalence among children and youth—30 percent—is well below the national Healthy People 2010 goal of 50 percent.

**Background.** The authors examined the risk of caries development in teeth with partially or fully lost sealant (formerly sealed [FS] teeth) relative to the risk in teeth that never have received sealants (never-sealed [NS] teeth).

**Methods.** The authors searched the population of studies used in five reviews of sealant effectiveness as established in split-mouth design studies involving resin-based sealants with no reapplication of lost sealant. They required included studies to contain sufficient data to estimate the risk of caries in FS teeth relative to that in NS teeth (relative risk [RR] = % FS developing caries / % NS developing caries) and its 95 percent confidence interval (CI). To estimate the mean RR by year since sealant placement, they used a weighted bivariate model and tested for heterogeneity using the quantity $I^2$.

**Results.** The weighted mean RR was 0.998 (95 percent CI, 0.817-1.220) one year after placement (four studies, 345 tooth pairs) and 0.936 (95 percent CI, 0.896-0.978) at four years (five studies, 1,423 tooth pairs).

**Conclusions.** Teeth with fully or partially lost sealant were not at a higher risk of developing caries than were teeth that had never been sealed.

**Clinical Implications.** Inability to provide a retention-check examination to all children participating in school sealant programs because of loss to follow-up should not disqualify a child from receiving sealants.

**Key Words.** Dental sealants; pit-and-fissure sealants; retention; caries.
target of 50 percent. Disparities exist according to income, with children from lower-income families about one-half as likely to have received a sealant as their counterparts from higher-income families.

School programs providing dental sealants are an important intervention to increase children’s receipt of sealants. On the basis of strong evidence of effectiveness, the independent, non-governmental Task Force on Community Preventive Services—a volunteer body of public health professionals—developed criteria for selecting interventions with strong evidence of effectiveness.

### TABLE 1

Description of studies used to determine risk of caries in formerly sealed teeth.

<table>
<thead>
<tr>
<th>STUDY CHARACTERISTIC</th>
<th>McCune and Colleagues, 1979, Colombia</th>
<th>Mertz-Fairhurst and Colleagues, 1984, United States</th>
<th>Charbonneau and Colleagues, 1977, United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age range (years)</td>
<td>6-9 CWF*</td>
<td>6-8 CWF</td>
<td>5-8 NR⁷</td>
</tr>
<tr>
<td>Background prevention exposure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caries severity threshold</td>
<td>One or more lesions§</td>
<td>One or more lesions</td>
<td>NR</td>
</tr>
<tr>
<td>Sealants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material¹</td>
<td>RB2</td>
<td>RB1⁶ and RB2‡</td>
<td>RB2</td>
</tr>
<tr>
<td>Tooth type sealed**</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Criteria for partial loss</td>
<td>Present on at least one occlusal region</td>
<td>Present on at least one occlusal region</td>
<td>NR</td>
</tr>
<tr>
<td>Criteria for full loss</td>
<td>Sealant not present on any occlusal region</td>
<td>Sealant not present on any occlusal region</td>
<td>NR</td>
</tr>
<tr>
<td>Complete retention rate (%)††</td>
<td>Y1 = 92, Y2 = 89, Y3 = 88</td>
<td>Y1 = 84, Y2 = 58, Y3 = 60, Y4.5 = 35</td>
<td>Y1.5 = 74, Y4 = 52</td>
</tr>
<tr>
<td>Study Quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of subjects at baseline‡‡</td>
<td>200</td>
<td>382</td>
<td>143</td>
</tr>
<tr>
<td>Teeth</td>
<td>636 NA</td>
<td>1,202</td>
<td>458</td>
</tr>
<tr>
<td>Sites</td>
<td>NA NA§</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Dropout rate (%)</td>
<td>Y1 = 14, Y2 = 21, Y3 = 15</td>
<td>Y1 = 21, Y2 = 19, Y3 = 34, Y4 = 42</td>
<td>Y1.5 = 16⁴⁵, Y4 = 19</td>
</tr>
<tr>
<td>Method of measurement of caries progression</td>
<td>VT##</td>
<td>VT</td>
<td>VT</td>
</tr>
<tr>
<td>Caries criteria</td>
<td>Consensus</td>
<td>Catch/softness and evidence of decalcification</td>
<td>Explorer catch and evidence of decalcification</td>
</tr>
<tr>
<td>Examiner agreement</td>
<td>Consensus</td>
<td>92%</td>
<td>Consensus</td>
</tr>
</tbody>
</table>

* CWF: Community water fluoridation.  
† NR: Not reported.  
‡ FMR: Fluoride mouthrinse delivered fortnightly.  
§ Lesion: Untreated or treated caries.  
‡‡ Estimated for teeth versus subjects.  
## VT: Visual/tactile.  
(Note that these numbers are for all subjects.)  

(continued on next page)
and prevention experts whose members are appointed by the director of the Centers for Disease Control and Prevention (CDC), Atlanta—issued a strong recommendation that school-based sealant programs be part of a comprehensive community strategy to prevent dental caries. The task force also acknowledged that these programs typically deliver services to children unlikely to receive them otherwise (such as children from lower-income families). School-based sealant programs also have the potential to link students with treatment services in the community.

One potential barrier to delivering sealants is the concern that a tooth with a partially lost sealant may be at a higher risk of developing caries than it would be if it never had been sealed. The theoretical rationale is that food particles could become trapped under a partially retained sealant, thus increasing the availability of nutrients for cariogenic bacteria. Because

<table>
<thead>
<tr>
<th>STUDY AUTHOR, YEAR STUDY PUBLISHED, SITE</th>
<th>Going and Colleagues, 1977, United States</th>
<th>Horowitz and Colleagues, 1976, United States</th>
<th>Leake and Martinello, 1976, Canada</th>
<th>Thystrup and Poulsen, 1976, Denmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total loss of material</td>
<td>Slight to severe loss of material</td>
<td>Part but not all of pit or fissure was not covered with sealant</td>
<td>Sealant can be demonstrated as present on some occlusal grooves and fissures</td>
<td>Sealant cannot be demonstrated over any of the occlusal grooves and fissures</td>
</tr>
<tr>
<td>Y1 = 81, Y2 = 69, Y3 = 56, Y4 = 50</td>
<td>None</td>
<td>None</td>
<td>Entirely missing</td>
<td>Entirely missing</td>
</tr>
<tr>
<td></td>
<td>RB1</td>
<td>RB1</td>
<td></td>
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<tr>
<td></td>
<td>M and PM</td>
<td>M</td>
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<tr>
<td></td>
<td>Slight to severe loss of material</td>
<td>Part but not all of pit or fissure was not covered with sealant</td>
<td>Sealant can be demonstrated as present on some occlusal grooves and fissures</td>
<td>Sealant cannot be demonstrated over any of the occlusal grooves and fissures</td>
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<tr>
<td></td>
<td>Total loss of material</td>
<td>Entirely missing</td>
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<tr>
<td></td>
<td>Y1 = 73, Y2 = 60</td>
<td></td>
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<tr>
<td></td>
<td>RB2</td>
<td>RB2</td>
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<td>Y1 = 73, Y2 = 60</td>
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<td>Y1 = 73, Y2 = 60</td>
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<td>Y1 = 73, Y2 = 60</td>
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<td>Entirely missing</td>
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<tr>
<td></td>
<td>Y1 = 73, Y2 = 60</td>
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school-based programs typically deliver sealants to children who are more likely to move during or between school years than are higher-income children, follow-up examinations for all children receiving sealants may not be possible. This concern about risks associated with sealant loss led a CDC-sponsored Expert Work Group that was developing guidelines for school-based sealant programs to request an analysis of relevant clinical studies. We were charged with carrying out this analysis. Therefore, the objective of our research was to determine if the risk of developing caries in a formerly sealed (FS) tooth with fully or partially lost sealant exceeds the risk in a never-sealed (NS) tooth.

MATERIALS AND METHODS

Inclusion criteria and identification and selection of studies. We searched MEDLINE and the Cochrane Library for systematic reviews of sealant effectiveness that were published in English from 1990 through 2005. Five systematic reviews, which included 37 unique studies, met these inclusion criteria. Two reviewers (S.K.G. and S.O.G.) screened these studies. They excluded 30 of the studies for the following reasons: publication in language other than English, adult rather than child or youth subjects, absence of concurrent comparison group that had not received sealants, intervention not involving placement of resin-based sealants on permanent posterior teeth with no reapplication, absence of description of caries status by retention status and absence of a split-mouth design.

Data abstraction and quality assessment. The same two reviewers independently abstracted data from the included studies. If there was disagreement on a specific item on the abstraction form, both reviewers re-examined the relevant portion of the study and reached consensus on the appropriate value. Because included studies were randomized controlled split-mouth trials and selected from among published systematic reviews that included explicit quality criteria for inclusion, we did not assign a quality score. However, we collected information on selected aspects of study quality (Table 1, page 416), including loss to follow-up and validity (caries assessment method) and reliability (examiner agreement) of caries status determination. Because studies involved randomized controlled trials with a split-mouth design, we determined it to be unlikely that initial assembly and maintenance of comparable groups was an issue. We also should note that it is difficult to blind examiners as to whether a sealant was placed or not placed unless the sealant was removed before follow-up, a scenario that is not typical in most sealant studies.

Outcome and risk measures. Our outcome measure was whether a tooth, when assessed at each annual follow-up examination, had developed caries. We compared the risk of developing caries in an FS tooth relative to that in an NS tooth, where relative risk (RR) = $\frac{\text{FS developing caries}}{\text{NS developing caries}}$.

RESULTS

Characteristics of studies. We included seven studies in the final body of evidence (Table 1). The publication date of the last report from each study ranged from 1976 to 1984. Three studies involved the use of ultraviolet light–polymerized resin-based sealant, which we designated “RB1”; three involved the use of autopolymerized resin-based sealant, which we designated “RB2”; and one involved the use of both RB1 and RB2. RB1 sealants have lower retention rates than do RB2 sealants, as evidenced by results from the latter study, in which about 70 percent of teeth classified as FS had received RB1 at the first two follow-up examinations. Researchers in all but one study...
reported data for permanent molars only.

Subjects’ ages ranged from 5 through 14 years. In three studies, investigators reported that subjects were exposed to fluoride via community water systems or mouthrinse program participation,13,14,22 two studies reported no fluoride exposure29,32 and two studies did not report background fluoride exposure.15,49 Caries incidence among NS teeth at the first-year follow-up examination ranged from 24 to 47 percent. Researchers in all studies used visual or tactile methods or both to assess caries; however, those in one study also used radiographs.49 For studies with more than one examiner, reported agreement among examiners (one study did not report agreement32) was greater than 90 percent. Loss to follow-up ranged from 5 to 21 percent for the five studies in which researchers conducted their first follow-up examination one to 1.5 years after placement,13-15,22, 29 and from 19 to 37.5 percent for the two studies in which investigators conducted their follow-up examinations four years after placement.32,49

For studies in which researchers reported sealant loss at the tooth level versus the site level,13-15,21,49 the mean percentage of FS teeth accounted for by partially lost sealants was at least 60 percent, up to and including three years after placement (Table 2). The mean percentage of FS teeth accounted for by partially lost sealants declined over time, and there did not appear to be a difference according to generation of sealant material. Two studies reported retention at the site level (pit and fissure; data not shown)32,49; in one of them,32 the proportion of FS teeth accounted for by partially lost sealants was 27 percent one year after placement and 32 percent two years after placement, and in the other study,32 it was 32 percent four years after placement.

The RR one year after placement (four studies,14,15,22,29 345 tooth pairs) ranged from 0.828 to 1.118 (Table 3, page 421). The weighted mean RR was 0.998 (95 percent CI, 0.817-1.220) and the median value was 0.941 (data not shown). For later years, the RR ranged from 0.467 to 1.186 with a weighted mean of 0.912 (95 percent CI, 0.793-1.048) at two years (four studies,13,14,22,29 481 tooth pairs), from 0.761 to 1.111 with a weighted mean of 0.901 (95 percent CI, 0.789-1.029) at three years (three studies,13,14,29 332 tooth pairs) and from 0.693 to 1.083 with a weighted mean of 0.936 (95 percent CI, 0.896-0.978) at four years (five studies,14,15,20,22,49 1,423 tooth pairs) (Table 3). The median RR was less than 1 for all years since sealant placement. In year 1, the I² statistic was negative, indicating that heterogeneity was not present. The I² statistic was always higher than 66 percent for later years, indicating that there were systematic differences among studies.

**DISCUSSION**

Our findings indicate that individual teeth with partial or complete loss of sealant are not at a higher risk of developing caries than they would be if they never had received sealants. The caries rate in FS teeth is less than or equal to the rate in NS teeth. The weighted mean RR was less than 1 for all four years after sealant placement, and the median RR also was less than 1 for all years after placement. Additionally, partially retained sealants accounted for the majority of FS teeth in most studies in which investigators collected data at the tooth level. In all studies, the RR of caries for FS teeth with partially lost sealants versus NS teeth was lower than the RR of caries for FS teeth with either partially or fully lost sealants versus NS teeth. In the remaining study, by Leake and Martinello,49 the RR of caries for FS teeth with partially lost sealants was the same as the RR of caries for FS teeth with either partially or fully lost sealants in comparison with teeth that never had received sealants. These findings suggest that heightened concern about partially lost sealants trapping food and thus increasing the risk of caries development may be unfounded.

Theoretically, it is possible that partially retained sealants may offer some protection, especially if a specific tooth site remains sealed. Indeed, in one study included in our analysis, Horowitz and colleagues32 found that sealant effectiveness increased with the extent of retention. One possible explanation as to why our review did not find an association is that the unit of observation (tooth) used in most studies was not sufficiently sensitive to detect a difference. For example, let us assume that all teeth without sealants develop caries and that 10 teeth, each
TABLE 2

Formerly sealed teeth: percentage partially retained, according to sealant material and interval since placement.*

<table>
<thead>
<tr>
<th>STUDY</th>
<th>SEALANT MATERIAL,† BY INTERVAL SINCE PLACEMENT</th>
<th>SEALANTS PARTIALLY RETAINED (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One Year</td>
<td></td>
</tr>
<tr>
<td>Going and colleagues</td>
<td>RB1</td>
<td>87</td>
</tr>
<tr>
<td>Mertz-Fairhurst and colleagues</td>
<td>RB1</td>
<td>64</td>
</tr>
<tr>
<td>MEAN</td>
<td>NA†</td>
<td>76</td>
</tr>
<tr>
<td>Mertz-Fairhurst and colleagues</td>
<td>RB2</td>
<td>46</td>
</tr>
<tr>
<td>McCune and colleagues</td>
<td>RB2</td>
<td>70</td>
</tr>
<tr>
<td>Charbeneau and colleagues</td>
<td>RB2</td>
<td>74</td>
</tr>
<tr>
<td>MEAN</td>
<td>NA</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>Two Years</td>
<td></td>
</tr>
<tr>
<td>Mertz-Fairhurst and colleagues</td>
<td>RB1</td>
<td>57</td>
</tr>
<tr>
<td>Going and colleagues</td>
<td>RB1</td>
<td>73</td>
</tr>
<tr>
<td>MEAN</td>
<td>NA</td>
<td>65</td>
</tr>
<tr>
<td>McCune and colleagues</td>
<td>RB2</td>
<td>64</td>
</tr>
<tr>
<td>Mertz-Fairhurst and colleagues</td>
<td>RB2</td>
<td>65</td>
</tr>
<tr>
<td>Charbeneau and colleagues</td>
<td>RB2</td>
<td>61</td>
</tr>
<tr>
<td>MEAN</td>
<td>NA</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Three Years</td>
<td></td>
</tr>
<tr>
<td>Mertz-Fairhurst and colleagues</td>
<td>RB1</td>
<td>52</td>
</tr>
<tr>
<td>Going and colleagues</td>
<td>RB1</td>
<td>70</td>
</tr>
<tr>
<td>MEAN</td>
<td>NA</td>
<td>61</td>
</tr>
<tr>
<td>McCune and colleagues</td>
<td>RB2</td>
<td>68</td>
</tr>
<tr>
<td>Mertz-Fairhurst and colleagues</td>
<td>RB2</td>
<td>53</td>
</tr>
<tr>
<td>Charbeneau and colleagues</td>
<td>RB2</td>
<td>59</td>
</tr>
<tr>
<td>MEAN</td>
<td>NA</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Four Years</td>
<td></td>
</tr>
<tr>
<td>Mertz-Fairhurst and colleagues</td>
<td>RB1</td>
<td>33</td>
</tr>
<tr>
<td>Going and colleagues</td>
<td>RB1</td>
<td>56</td>
</tr>
<tr>
<td>Leake and Martinello</td>
<td>RB1</td>
<td>2</td>
</tr>
<tr>
<td>MEAN</td>
<td>NA</td>
<td>30</td>
</tr>
<tr>
<td>Mertz-Fairhurst and colleagues</td>
<td>RB2</td>
<td>49</td>
</tr>
<tr>
<td>Charbeneau and colleagues</td>
<td>RB2</td>
<td>53</td>
</tr>
<tr>
<td>MEAN</td>
<td>NA</td>
<td>51</td>
</tr>
</tbody>
</table>

* Thylstrup and Poulsen and Horowitz and colleagues not included because these studies collected retention data at the site level versus the tooth level. Percentage of formerly sealed teeth accounted for by partially retained sealant was 32 percent and 27 percent for years 1 and 2, respectively, in Thylstrup and 32 percent in Horowitz.
† RB1: Ultraviolet (UV) light–polymerized resin-based sealant. RB2: Autopolymerized resin-based sealant.
‡ NA: Not applicable.
§ Sealant loss rate is higher than in the other studies. Clinicians reported difficulty in adapting to field equipment. Variation in the intensity of the UV light from the polymerization unit also was reported. This unit was one of the first manufactured to meet Canadian electrical standards; the investigators tried to compensate by increasing sealant exposure to UV light from 30 to 45 seconds.

with two sites, are sealed while their contralateral teeth remain unsealed. If one site on each tooth lost its sealant while the other site remained sealed, then the RR calculated at the tooth level would be 100 percent/100 percent = 1, while the RR at the site level would be 50 percent/100 percent = 0.5. In the two studies that used site as the unit of measurement, both had an RR of less than 1. However, only one study did not include 1 in the 95 percent CI.

We compared the caries in FS teeth with that in NS teeth at the individual tooth level. It is important to note, however, that at the community level, the relevant question is not a direct comparison of caries rates in FS and NS teeth but rather a comparison of the caries rate in the group with sealed teeth (FS teeth plus fully retained sealants) versus the caries rate in the group with NS teeth. It must be remembered that the caries rate in the group with sealed teeth is based on the sealant loss rate and the caries rate in teeth that lost sealants (that is, FS teeth).
Researchers conducting a systematic review that included only studies in which lost sealants were not reapplied found that sealants reduced caries by more than 70 percent. This finding indicates that the sealant loss rate multiplied by the caries rate in the group with FS teeth is less than the caries rate in the group with NS teeth or, equivalently, that the benefits of delivering sealants to children for whom follow-up cannot be ensured exceed the potential risks. Additionally, the findings of our study indicate that at the individual tooth level, the risk of caries development in FS teeth does not exceed that in NS teeth.

Because current guidance recommends sealant placement only when there is a risk of caries development and because sealant effectiveness is linked directly to retention, the maximum protection against caries can be achieved when a sealant is fully retained. Our findings do not suggest that practitioners can be any less careful in their sealant-application technique or in the evaluation or maintenance of sealants after placement in clinical practice. Our findings, however, do suggest that a child should not be deprived of the benefits of a sealant even when follow-up care cannot be ensured.

If we consider Cochrane inclusion/exclusion criteria for study design as the gold standard, then the overall quality of studies included in this review was good. Of the four studies included in this review that were not in the Cochrane review, three were randomized controlled...
trials and had dropout rates meeting the Cochrane criteria. Of these three studies, two were excluded from the Cochrane review because they did not meet the intervention criteria of RB2 sealant material,23,40 and one was excluded because the children in the study participated in a biweekly mouthrinse program.22 One additional study had a four-year dropout rate of 37.5 percent.32 The Cochrane review excluded studies with three-year dropout rates exceeding 30 percent and did not specify a threshold for four years after sealant placement.

One limitation of this analysis was the finding of heterogeneity for pooled results two to four years after sealant placement. The presence of heterogeneity suggests that there were significant differences between studies. These differences may not be as important in this study, in which our primary purpose was to determine if the preponderance of evidence indicated that FS teeth were at greater risk of developing caries than were NS teeth. We were not trying to obtain a precise point estimate of effect. For four of the seven studies included in this review, the point estimate of the RR for each year since sealant placement was always less than 1. In only one of the remaining three studies was the RR consistently above 1, and in that study the highest point estimate of the RR was 1.186.

Finally, we limited our search to studies included in systematic reviews of sealant effectiveness. For this analysis, we chose a less resource-intensive method to identify and screen potential studies. This approach is attractive because it provides an efficient method of collecting data from well-conducted studies. The studies included in systematic reviews have met rules of study design, conduct and measurement. In addition, we minimized bias in selecting studies for this analysis because the authors of the original systematic reviews determined the universe of studies. Inclusion and exclusion criteria in this analysis were explicit, and we specified them before screening available studies.

All but one of the studies included in this analysis were published in the 1970s, when fluoride exposure was lower. Furthermore, in some of the studies we included, researchers used a generation of sealant material (RB1) that no longer is commercially available in the United States. It is unlikely, however, that these factors influenced our findings. Among this group of studies, the RR did not appear to vary according to background fluoride exposure or generation of sealant material.

CONCLUSION

The values for both the weighted mean and the median RR suggest that FS teeth with fully or partially lost sealant were not at a higher risk of developing caries than were NS teeth. Thus, the inability to provide a retention examination to all children participating in school-based sealant programs because of potential loss to follow-up should not exclude any child from having access to the well-documented caries-preventive benefit of a retained sealant.

Disclosures. Dr. Malvitz and Dr. Gray work for the Centers for Disease Control and Prevention under contracts with Palladian Partners, Silver Spring, Md., and Northrop Grumman, Atlanta, respectively. None of the other authors reported any disclosures.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the U.S. Centers for Disease Control and Prevention.
The Effectiveness of Sealants in Managing Caries Lesions

INTRODUCTION

There is strong evidence that sealants are effective in both clinical and school settings for preventing caries in children at various levels of risk (Truman et al., 2002; Ahovuo-Saloranta et al., 2004). The evidence for sealant effectiveness in the management of dental caries is limited, however. One review that examined the effectiveness of interventions to manage caries for the National Institutes of Health (NIH) Caries Consensus Development Conference included only 1 study on sealants (Bader et al., 2001). Despite the strong evidence of primary effectiveness, sealant prevalence among lower-income children (who are at higher risk for dental caries) is about 30% (Dye et al., 2007), well below the Healthy People 2010 objective of 50%.

Analysis of survey data from dentists suggests that one barrier to providing sealants is concern about inadvertently sealing over caries (Chapko, 1987; Primosch and Barr, 2001). This concern has also been a barrier to implementing school-based sealant programs (Association of State and Territorial Dental Directors, unpublished data, 2005).

Documenting the effectiveness of sealants in the management of existing caries is therefore important, and such documentation could potentially remove barriers to the provision of a proven intervention. The purpose of this meta-analysis is to examine the effectiveness of dental sealants in preventing the progression of caries lesions in the pits and fissures of permanent teeth.

METHODS

Inclusion Criteria

This analysis was part of a broader systematic review of sealant effectiveness in the management of caries in the permanent dentition. Initially, we included all in vivo studies published in English that compared caries progression or bacteria levels in permanent teeth that did and did not receive sealants. Comparisons could be concurrent or measured over time (time-series or before-after) in the same groups. In the current meta-analysis, study designs were limited to randomized and non-randomized controlled trials and cohort studies that provided concurrent comparisons of % of lesions progressing. There were no restrictions on study populations.

Identification of Studies

In our search of MEDLINE (1966 to June, 2005), using a modified version of the strategy used by the NIH Caries Consensus Development Conference (University of Michigan, 2003), we identified 1872 records. The MEDLINE search strategy was adapted to search EMBASE (1980 to June, 2005), which identified 71 records, and the Cochrane Central Register of Controlled Trials (accessed the first week of September, 2005), which identified 79 records. In total, there were 1905 unique records. Two reviewers independently examined the titles and abstracts of these records for systematic or narrative reviews of the effectiveness of sealants in preventing or managing caries and primary studies on managing caries. We accessed 262 articles. From our examination of their titles and abstracts, we identified 156 articles for full-text review.

ABSTRACT

A barrier to providing sealants is concern about inadvertently sealing over caries. This meta-analysis examined the effectiveness of sealants in preventing caries progression. We searched electronic databases for comparative studies examining caries progression in sealed permanent teeth. We used a random-effects model to estimate percentage reduction in the probability of caries progression in sealed vs. unsealed carious teeth. Six studies, including 4 randomized-controlled trials (RCT) judged to be of fair quality, were included in the analysis (384 persons, 840 teeth, and 1090 surfaces). The median annual percentage of non-cavitated lesions progressing was 2.6% for sealed and 12.6% for unsealed carious teeth. The summary prevented fraction for RCT was 71.3% (95%CI: 52.8%-82.5, no heterogeneity) up to 5 years after placement. Despite variation among studies in design and conduct, sensitivity analysis found the effect to be consistent in size and direction. Sealing non-cavitated caries in permanent teeth is effective in reducing caries progression.

Key Words: pit and fissure sealants, caries.
references, we accessed an additional 49 articles, for a total of 311.

Study Selection

One investigator (SG) screened all articles and identified 31 potential qualifying studies. After review by three investigators (BG, SG, and WK), consensus was reached that 26 studies should be evaluated further. Of the 19 studies included in the larger systematic review, 10 had information on % of lesions progressing. Of these 10 studies, 6 had a concurrent control group (see QUOROM flow diagram in APPENDIX).

Data Abstraction and Quality Assessment

Two reviewers (SG and EO) abstracted studies using a slightly modified version of a form developed for the NIH Caries Consensus Conference. The abstraction forms were jointly reviewed by three investigators (BG, SG, and EO) to assess study quality using criteria established by the third US Preventive Services Task Force (USPSTF; Harris et al., 2001). These criteria are further described in the APPENDIX.

Outcome and Effect Measures

Our outcome measure was the percentage of caries lesions progressing, where progression was defined as demineralization or loss of tooth structure. In 4 studies, restorations were placed after study examiners determined that caries progression had exceeded given thresholds. For 2 studies, where children had access to outside care, placement of a restoration indicated caries progression. To measure effectiveness, we calculated the relative risk ratio (RR) and its 95% confidence interval (CI). One can obtain the prevented fraction by subtracting the RR from 1, and the upper/lower 95%CI by subtracting the lower/higher 95%CI of the RR ratio from 1.

Synthesis of Findings

We calculated the median percentage of lesions progressing in
sealed and unsealed surfaces, as well as the median prevented fraction, for all studies and for subgroups of studies with selected characteristics. We classified baseline caries as non-cavitated if the study described caries as incipient or restricted to the enamel, or if there were no apparent defects in the enamel, or the lesion did not permit explorer penetration. We classified caries as cavitated if the study stated that cavitation was visually detectible, or the lesion allowed for explorer penetration.

In adjusting the data for differences in study design, multiple observations per subject, and 100% or 0% progression rates (LaPlace adjustment), we made conservative assumptions that would bias the results toward finding no statistical significance (APPENDIX). We used the Der Simonian and Laird (DSL) random-effects model (Stijnen, 1999) to obtain the summary RR and its 95% confidence interval. We tested for homogeneity of effect size using the quantity I² (Higgins et al., 2003). Finally, we conducted sensitivity analysis to determine how robust our findings were to excluding cohort studies and assuming higher values of intra-oral correlation (APPENDIX).

RESULTS

Characteristics of Studies

The 6 studies included in this analysis (representing an estimated 384 persons, 840 teeth, and 1090 surfaces) varied in design (4 RCTs), baseline caries classifications, and types of sealant material (Table 1). Four studies primarily sealed non-cavitated lesions, 1 exclusively sealed cavitated lesions, and 1 sealed both cavitated and non-cavitated lesions. Three studies used 2nd- or 3rd-generation resin-based sealants, 2 used glass-ionomer cement (GIC), and 1 used 1st-generation resin-based sealants. Study populations included children, adolescents, and young adults ranging in age from 6 to 19 yrs.

Quality of Studies

All the studies were rated as "fair" quality (Table 2). It is likely that comparable groups were assembled in 5 studies—4 RCTs and 1 cohort study where baseline sealant prevalence and DFS did not differ between the sealed and not-sealed groups. All studies clearly defined the intervention. The 2 cohort studies did not report drop-out rates, and 1 RCT of split-mouth design reported a one-year drop-out rate of 30%. In the 3 remaining RCTs, however, the one-year drop-out rate was less than 10% (this included the 2 larger studies that supported subgroup analyses of sealed caries lesions).

In the absence of sealant removal prior to follow-up examination, we assumed that outcome assessment was not blinded. In only 1 RCT, however, were sealants removed prior to the follow-up examination, with teeth assessed by an examiner who did not know the initial group assignment. In 2 of the remaining 5 studies (1 RCT and 1 cohort study), however, either the examiner used new record forms at each follow-up examination (and thus was unaware of the child's previous findings), or there was an independent outside examiner. In the remaining 3 studies (2 RCTs and 1 cohort study), either the same examiner conducted both the baseline and follow-up examinations, or blinding was not described.

Effects of Sealants

The median annualized progression rates for sealed and unsealed lesions were, respectively, 5.0% and 16.1% (Table 3). If we classified all teeth in the study by Going et al. (1976) as cavitated, then, the annualized progression rates for cavitated lesions would be 19.4% (sealed) and 59.3% (not-sealed). The percentage of non-cavitated lesions progressing would be 2.6% (sealed) and 12.6% (not-sealed). Alternatively, if we classified all teeth in the Going study as non-cavitated, then the median annualized progression rates for non-cavitated lesions would be 2.9% (sealed) and 13.6% (not-sealed), respectively.

For the individual studies, the prevented fraction ranged from 61.6% to 100.0%, with a median of 74.2% (Table 3). If we classified all teeth in the study by Going et al. (1976) as cavitated, then, the annualized progression rates for cavitated lesions would be 19.4% (sealed) and 59.3% (not-sealed). The percentage of non-cavitated lesions progressing would be 2.6% (sealed) and 12.6% (not-sealed), respectively. Alternatively, if we classified all teeth in the Going study as non-cavitated, then the median annualized progression rates for non-cavitated lesions would be 2.9% (sealed) and 13.6% (not-sealed), respectively.

The RR for the studies ranged from 0 to 38.4%, but after the LaPlace adjustment, it ranged from 20.8% to 53.2% (Fig.). The CI for each study widened as we made more conservative assumptions about correlation among teeth (Fig.), but changing the assumptions about correlation did not result in rejecting findings of
statistical significance for any of the 4 studies whose initial 95% CI did not achieve 100%.

The summary prevented fraction ranged from 73.2% (95% CI: 59.8%-82.2%), assuming perfect correlation among teeth (adjusted n = 398), to 75.0% (95% CI: 67.1%-81.1%), assuming no correlation (adjusted n = 946), and equaled 74.1% (95% CI: 63.8%-81.4%), assuming 30% correlation (adjusted n = 638). When we

| Table 2. Quality Assessment of 6 Studies with Concurrent Controls |
|------------------|------------------|------------------|
| Criteria | Flório et al., 2001 | Frencken et al., 1998 | Gibson and Richardson, 1980 | Going et al., 1976 | Heller et al., 1995 | Mertz-Fairhurst et al., 1986 |
| Initial assembly of comparable groups | Good—RCT\(^a\), employing parallel group design, where children were randomly assigned to treatment group. | Fair—assignment based on returned permission slip. | Good—RCT with split-mouth design, where treatment teeth determined by dice. | Good—RCT with split-mouth design, where side of mouth receiving treatment was randomly selected. | Good—although assignment based on returned permission slip, study showed that baseline DFS did not differ between control and treatment groups. | Good—RCT with split-mouth design, where treatment tooth decided via randomized treatment assignment sheet. |
| Reliability and validity of measure of outcome | Fair—blinding not specified and whether same examiner interpreted digital radiographs at BL and FU indeterminant. | Fair—VT\(^b\) and sealants not removed at FU; outside examiner. | Fair—no blinding and same examiner conducted VT BL\(^c\) examination and read radiographs at FU; 71% of lesion progression due to restorations. | Fair—although examiners blinded as to previous caries score, carries score determined by VT and sealants not removed at FU, although new record forms were used at each examination. | Fair—no blinding, same examiner (not a primary investigator) at BL and FU, and VT where sealants not removed at FU, although subjects received regular clinical care (59% of sites progressing due to restorations). | Good—removed sealant, and blinded examiners assessed lesion progression. |
| No differential loss to FU or overall high loss to FU | Good—drop-out rate was 9%. | Fair—number of controls not reported. | Fair—drop-out rates not reported for subgroup; for entire study, 1- and 2-year drop-out rates for tooth pairs were 8 and 17%, respectively. | Fair—drop-out rates not reported for subgroup; for entire study, 1-year drop-out rate for subjects was 6%. | Fair—retrospective cohort study, so drop-out rate not reported. | Fair—1-year drop-out rate was 30%. |
| Quality score | Fair | Fair | Fair | Fair | Fair | Fair |

\(a\) RCT = randomized controlled trial.  
\(b\) VT = visual tactile examination.  
\(c\) FU = follow-up examination.  
\(d\) BL = baseline examination.
only randomized trials, which indicated no observed heterogeneity.

**DISCUSSION**

We found that sealing caries lesions reduced the probability of lesion progression. The summary prevented fraction was more than 70%, and in the sensitivity analyses, the lower bound of the 95%CI always exceeded 50%. The consistency in size and direction across included studies and under a range of conservative assumptions indicates that the findings are robust.

Because non-cavitated lesions accounted for almost 90% of teeth in this study, the evidence supporting the sealing of non-cavitated lesions (NC) was stronger than that for the sealing of cavitated (C) lesions. The median annualized probability of progression for NC lesions was very low (2.6%). This finding does not support reported concerns about poorer outcomes associated with the inadvertent sealing of caries and should lessen the reluctance of practitioners to provide sealants—an intervention proven to be highly effective in preventing caries. The annualized probability reflects progression in lesions recognized as "early or incipient" and suggests that the probability of progression for pit-and-fissure surfaces with caries considered "questionable" could be even lower. These findings not only support the placement of sealants to manage and arrest lesions in the early stages, but also, just as importantly, support their placement for surfaces where caries status is uncertain.

Another notable finding of this review was the low annualized probability of progression (12.6%) for not-sealed, non-cavitated lesions. This finding suggests that immediate surgical treatment of lesions is uncertain.

Table 3. Percentages of Sealed and Unsealed Caries Lesions Progressing and Prevented Fraction for Different Subgroups

<table>
<thead>
<tr>
<th></th>
<th>No. Teeth</th>
<th>No. Persons</th>
<th>No. Studies</th>
<th>Sealed Caries Lesions (%)</th>
<th>Unsealed Caries Lesions (%)</th>
<th>Prevented Fraction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median°</td>
<td>Range</td>
<td>Median°</td>
<td>Range</td>
<td>Median°</td>
<td>Range</td>
</tr>
<tr>
<td>All</td>
<td>840</td>
<td>384</td>
<td>6</td>
<td>9.6</td>
<td>0.286</td>
<td>41.4</td>
</tr>
<tr>
<td>RCT°</td>
<td>254</td>
<td>140</td>
<td>4</td>
<td>13.1</td>
<td>0.286</td>
<td>48.0</td>
</tr>
<tr>
<td>&lt;= 12 mos</td>
<td>175</td>
<td>91</td>
<td>3</td>
<td>7.1</td>
<td>0.286</td>
<td>18.6</td>
</tr>
<tr>
<td>30-36 mos</td>
<td>447</td>
<td>222</td>
<td>2</td>
<td>13.7</td>
<td>8.4-19.0</td>
<td>54.2</td>
</tr>
<tr>
<td>60 mos</td>
<td>218</td>
<td>71</td>
<td>1</td>
<td>10.8</td>
<td>—</td>
<td>51.8</td>
</tr>
<tr>
<td>GICc</td>
<td>430</td>
<td>193</td>
<td>2</td>
<td>4.2</td>
<td>0.8-4.8</td>
<td>18.6</td>
</tr>
<tr>
<td>RB1d</td>
<td>85</td>
<td>57</td>
<td>1</td>
<td>7.1</td>
<td>—</td>
<td>18.6</td>
</tr>
<tr>
<td>RB2e &amp; RB3f</td>
<td>225</td>
<td>134</td>
<td>3</td>
<td>19.0</td>
<td>10.8-28.6</td>
<td>77.4</td>
</tr>
<tr>
<td>Non-cavitated</td>
<td>727</td>
<td>313</td>
<td>4</td>
<td>9.6</td>
<td>0.19-0.9</td>
<td>41.4</td>
</tr>
<tr>
<td>Cavitatedd</td>
<td>113</td>
<td>71</td>
<td>2</td>
<td>17.9</td>
<td>7.1-28.6</td>
<td>59.3</td>
</tr>
</tbody>
</table>

° In most cases, mean was fairly close to median value.

The same review found limited evidence to support the effectiveness of GIC sealant material as a primary preventive measure. A longitudinal study that sampled 24 teeth found no difference in bacteria levels between dentinal lesions sealed with resin-based and GIC sealants 7 mos after placement (Weerheijm et al., 1993).

The studies also varied by how they assessed caries progression. Three studies assessed progression solely with a visual-tactile examination. In the absence of sealant loss or a restoration on a previously sealed caries lesion, visual-tactile assessment of caries under sealants is limited. In 1 of the 3 studies included in our meta-analysis, however, children received regular restorative care, and thus it is likely that sealed teeth were periodically assessed radiographically and restored if necessary.

All RCTs (4 studies) included in this review received a "fair" quality rating, primarily due to failure to blind outcome assessment (3 studies) and high loss to follow-up (1 study). It should be noted, however, that comparative studies examining the effectiveness of sealants for primary prevention typically do not remove sealants at follow-up. For example, none of the studies included in a recent systematic review of sealants removed sealant at the final follow-up examination (Ahovuo-Saloranta et al., 2004).

While limitations of this analysis have been carefully described, the strengths of these studies, and of the meta-analysis as well, should be clearly noted. First, we conducted a sensitivity analysis that adjusted for correlation among multiple observations.
per person to determine the most conservative (widest) confidence interval for the summary prevented fraction. Other systematic reviews of sealant effectiveness have included studies with multiple observations per person, and this systematic review is likely the first study that adjusted data for this limitation. In addition, the consistency of the effect measure across studies also lends support for the quality of the 6 studies; it is very unlikely that such consistency among estimates based on studies with noted variations occurred by chance alone.

There is additional evidence for sealant effectiveness in the management of caries. Two other studies identified in the larger systematic review also examined the impact of sealants on caries progression, but did not report % of lesions progressing. One study found that caries lesions measured by radiographic assessment were more likely to regress under intact sealants than under defective sealants (Handelman et al., 1986). Another RCT found that the mean depth change in caries lesions was significantly lower in the sealed group than in the not-sealed group (49 µm vs. 614 µm depth change; Mertz-Fairhurst et al., 1979). In addition, several studies have found that sealing caries reduces bacteria levels (Jeronimus et al., 1975; Jensen and Handelman, 1980).

This review also supports the need for further studies that meet current standards of quality in design, conduct, and reporting, to continue to build the evidence related to sealant effectiveness in preventing caries progression, especially in cavitated lesions, which represented, at most, 14% of carious teeth in this analysis. Uniform criteria to assess progression from early demineralization to frank cavitation, as well as standardized methodologies to measure progression, are needed. This review would have been strengthened if all studies had used examiners calibrated to the same criteria and the same method to assess caries progression (i.e., visual-tactile examination with removal of sealants).

In conclusion, the evidence supports the placement of sealants over non-cavitated caries lesions in the pits and fissures of permanent teeth in children, adolescents, and young adults. Despite variations in study design and conduct, subgroup and sensitivity analyses found the effect to be consistent in size and direction.

ACKNOWLEDGMENTS

This research was funded by the Centers for Disease Control and Prevention. We also thank Sylvia Bickley, Trials Service Coordinator, Cochrane Group, for her assistance.

REFERENCES


Guiding Principles of Infection Control:

PRINCIPLE 1. TAKE ACTION TO STAY HEALTHY

PRINCIPLE 2. AVOID CONTACT WITH BLOOD AND OTHER POTENTIALLY INFECTIOUS BODY SUBSTANCES

PRINCIPLE 3. MAKE PATIENT CARE ITEMS (instruments, devices, equipment) SAFE FOR USE

PRINCIPLE 4. LIMIT THE SPREAD OF BLOOD AND OTHER INFECTIOUS BODY SUBSTANCES

Levels of Anticipated Contact between the dental health care professional (DHCP) or volunteer and the patient’s mucous membranes, blood or saliva visibly contaminated with blood to determine the suggested elements for the infection control program. This checklist is designed to provide information for 3 levels of programs:

I. Anticipated contact with the patient’s mucous membranes, blood or saliva visibly contaminated with blood.

II. Anticipated contact with the patient’s mucous membranes but not with blood or saliva visibly contaminated with blood.

III. No anticipated contact with the patient’s mucous membranes, blood, or saliva visibly contaminated with blood.

IMPORTANT DISCLAIMER: Although the Organization for Safety, Asepsis and Prevention (OSAP) believes that the information contained herein in accurate, it necessarily reflects OSAP’s interpretation of CDC guidelines. Moreover, inadvertent errors may occur. Accordingly, OSAP makes no representations of any kind that its interpretations are always correct, complete or up-to-date and expressly disclaims any representation that this checklist satisfies any applicable standard of care. Users of this checklist are encouraged to read the Centers for Disease Control and Prevention guidelines and reach their own conclusions regarding any matter subject to interpretation. OSAP shall not be liable for any direct, indirect, incidental, special or consequential damages resulting from the user’s reliance upon the material contained herein.
**Infection Control Checklist for Dental Settings Using Mobile Vans or Portable Dental Equipment**

**ALL PROGRAMS SHOULD MEET THE MINIMUM REQUIREMENTS BASED ON THE CENTERS FOR DISEASE CONTROL AND PREVENTION’S (CDC) GUIDING PRINCIPLES OF INFECTION CONTROL**

<table>
<thead>
<tr>
<th>Level I</th>
<th>Level II</th>
<th>Level III</th>
<th>INFECTION CONTROL PRACTICE</th>
<th>Yes</th>
<th>No</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Infection Control Program Operating Procedures</td>
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<td></td>
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</tr>
<tr>
<td></td>
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<td>Is there a written infection control program?</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Is there a designated person(s) responsible for program oversight?</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Are there methods for monitoring and evaluating the program?</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Is there a training program for dental health-care personnel (DHCP) (initial and ongoing) in infection control policies and practices?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Immunizations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Are DHCP adequately immunized against vaccine-preventable diseases?</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Immunizations should meet or exceed federal, state and local guidelines. (May not be necessary for screenings)</td>
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<td></td>
<td></td>
<td></td>
<td>Hepatitis B</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Annual Influenza</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Additional immunizations needed for program:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Hand Hygiene</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Are sinks available close to the area where care is provided?</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If not, are alcohol-based hand sanitizers available?</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Is staff properly trained in the use of alcohol handrub products?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td></td>
<td>Personal Protective Equipment (PPE) (e.g., gloves, masks, protective eyewear, protective clothing)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Is there a protocol that outlines what PPE are worn for which procedures?</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Is PPE storage available and close to care?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Are facilities available to disinfect PPE (DHCP eyewear, patient eyewear, heavy duty utility gloves)?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Infection Control Checklist for Dental Settings Using Mobile Vans or Portable Dental Equipment

<table>
<thead>
<tr>
<th>Level I</th>
<th>Level II</th>
<th>Level III</th>
<th>INFECTION CONTROL PRACTICE</th>
<th>Yes</th>
<th>No</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>X</td>
<td>As necessary</td>
<td>Environmental Surfaces: Clinical Contact Surfaces (e.g., light handles and countertops)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Is there a list of what surfaces will be cleaned, disinfected or barrier protected and the process and products to be used?</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If chemical disinfectants are used, is there a protocol for how they are managed, stored and disposed?</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td></td>
<td>Housekeeping Surfaces (e.g., floors, walls)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Is there a list of which housekeeping surfaces will need to be cleaned and disinfected and how often?</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td></td>
<td>Safe Handling of Sharp Instruments and Devices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Are DHCP trained in the safe handling and management of sharps?</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Are sharps containers safely located as close as possible to the user?</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Is there a written protocol for transporting and disposing of sharps and sharps containers?</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td></td>
<td>Management and Follow-Up of Occupational Exposures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Is there a written procedures manual for post-exposure management?</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Is there a designated person responsible for post-exposure management?</td>
<td>Yes</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Is there a mechanism to document the exposure incident?</td>
<td>Yes</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Where is the closest medical facility for wound care and post-exposure management?</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Is there a mechanism to refer the source and DHCP for testing and follow-up?</td>
<td>Yes</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Is there a mechanism for expert consultation by phone?</td>
<td>Yes</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Are post-exposure prophylaxis medications readily available onsite, at an emergent care facility or nearby pharmacy?</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Who is the responsible party for post-exposure care costs?</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Does Workers’ Compensation apply?</td>
<td>Yes</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Have DHCP been trained in post-exposure management procedures?</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level I</td>
<td>Level II</td>
<td>Level III</td>
<td>INFECTION CONTROL PRACTICE</td>
<td>Yes</td>
<td>No</td>
<td>Comments</td>
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<tr>
<td>X</td>
<td>X</td>
<td>If used</td>
<td><strong>Reusable Patient Items</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Are reusable patient items processed onsite?</td>
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<td></td>
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<td></td>
<td><strong>IF YES:</strong></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Is there a protocol for how and where contaminated instruments are cleaned and processed?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>If used</td>
<td><strong>Reusable Patient Items, continued</strong></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Is there adequate space for the processing area to be divided into clean and dirty areas?</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Has the person who is performing the processing been adequately trained?</td>
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<td></td>
<td></td>
<td></td>
<td>Is the sterilizer(s) spore tested at least weekly?</td>
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<td></td>
<td>Are protocols in place to handle positive tests?</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Can dental equipment and patient items be safely stored and secured if left on site?</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td><strong>IF NO:</strong></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Is there an adequate inventory of instruments for the number of patients to be treated?</td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td>Are containers for holding or transporting contaminated instruments puncture-proof, secured, &amp; labeled as a biohazard?</td>
<td></td>
<td></td>
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<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td><strong>Single-Use (Disposable) Items and Devices</strong></td>
<td></td>
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<td></td>
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<tr>
<td></td>
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<td></td>
<td>Is there a protocol for which single-use, disposable items will be used and how they will be disposed? e.g., gloves, tongue depressors</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Are disposable items unit-dosed for each patient?</td>
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<tr>
<td></td>
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<td></td>
<td>Are syringes that deliver sealant and composite material barrier-protected if they aren’t single-use, disposable syringes?</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td><strong>Management of Dental Unit Water Quality</strong></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Is there a protocol for how dental unit water quality will be maintained and monitored?</td>
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<tr>
<td>Level I</td>
<td>Level II</td>
<td>Level III</td>
<td>INFECTION CONTROL PRACTICE</td>
<td>Yes</td>
<td>No</td>
<td>Comments</td>
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</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Management of Regulated and Non-Regulated Medical Waste</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Is there a protocol and designated person responsible for proper disposal of regulated waste (e.g., sharps containers, extracted teeth) and non-regulated waste (regular trash)?</td>
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</tbody>
</table>
A Best Practice Approach Report describes a public health strategy, assesses the strength of evidence on the effectiveness of the strategy, and uses practice examples to illustrate successful/innovative implementation.

Date of Initial Report: June 16, 2003
Updated – August 2014

Best Practice Approach
School-based Dental Sealant Programs

I. Description (page 1)
II. Guidelines and Recommendations (page 7)
III. Research Evidence (page 8)
IV. Best Practice Criteria (page 9)
V. State Practice Examples (page 9)
VI. Acknowledgements (page 13)
VII. Attachments (page 14)
VIII. Resources (page 15)
IX. References (page 15)

Summary of Evidence Supporting School-based Dental Sealant Programs

<table>
<thead>
<tr>
<th>Evidence Type</th>
<th>Rating</th>
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<tbody>
<tr>
<td>Research</td>
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</tr>
<tr>
<td>Expert Opinion</td>
<td>+++</td>
</tr>
<tr>
<td>Field Lessons</td>
<td>++</td>
</tr>
<tr>
<td>Theoretical Rationale</td>
<td>+++</td>
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</tbody>
</table>

See Attachment A for details.

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I. Description

A. Dental Sealants

Dental sealants are clear or opaque plastic materials applied to the occlusal pit-and-fissure (biting) surfaces of teeth to prevent tooth decay (dental caries). Sealants prevent initiation and arrest progression of tooth decay by providing a physical barrier against microorganisms and food particles that collect in pits and fissures. (1) About 90 percent of decay occurs in the pits and fissures of permanent posterior teeth (2) with the molars being at highest risk. (3) National data show that children from low-income families have a significantly higher proportion of untreated caries compared to children from high-income families. Only 25% of 6–9 year olds from low-income families had sealants compared to 34% of children from high-income families (25.5%). (4)

The Surgeon General’s Report Oral Health in America: A Report of the Surgeon General noted that sealants are an efficient use of resources when used in populations with higher-than-average disease incidence rates and when sealants are placed on teeth at highest risk for caries. (5)

Based on recommendations and reviews by a panel of experts supporting the Task Force on Community Preventive Services, the Guide to Community Preventive Services (The Community Guide) strongly recommends school-based and school-linked dental sealant delivery programs for preventing or reducing occlusal caries on posterior teeth of children. (6)

B. Dental Sealant Programs

Dental sealant programs generally are targeted to vulnerable populations less likely to receive dental care that could benefit from sealants, such as children eligible for free or reduced-cost meal
programs. Schools are an ideal place to reach children. School-based sealant programs have been associated with reducing the incidence of tooth decay by 40 to 60 percent.\(^{(6, 7)}\)

There are variations in how dental sealant programs are designed:

- **School-based programs** are conducted completely within the school setting, with teams of dental health professionals such as dentists or dental hygienists utilizing portable equipment or in a fixed clinical facility within the school setting or in a mobile dental van parked on school property.

- **School-linked programs** are connected with schools, but deliver the sealants at a site other than the school (e.g., a clinic or private dental office). School-linked programs may present information, distribute consent forms and conduct dental screening at schools.

- **Hybrid programs** incorporate school-based and school-linked services.

School-based and school-linked dental sealant programs have the potential to link students with treatment and ongoing care in a dental home in the community where dental care should be comprehensive, continuously accessible, coordinated, and family-centered. \(^{(8)}\) Community-based sealant programs are not meant to be a replacement for a dental home.

Over the past four years the Synopses of State Dental Public Health programs has shown that more than 50% of the states/DC have programs for dental sealants (in one or more of the program design variations described previously). In FY 2011-2012, 68.6% of states/DC reported having a dental sealant program.\(^{(9)}\)

In 2010 and 2011, the Pew Children’s Dental Campaign assessed and graded 50 states/DC on eight policy benchmarks that ensure dental health and access to care for disadvantaged children.\(^{(10, 11)}\) Two of these eight policy benchmarks focused on dental sealants (Table 1). The first benchmark was selected because children from low-income families are at higher risk for tooth decay and less likely to have received dental sealants compared to their higher-income counterparts.\(^{(4)}\) Thus it is important to know the distribution of sealant programs in high-need schools that serve at risk children. The second benchmark addresses State Dental Practice Acts as research shows that sealant programs in states with less restrictive practice acts are more cost effective.\(^{(12)}\)

<table>
<thead>
<tr>
<th>Table 1: Pew Center on the States Sealant Policy Benchmarks 2010, 2011 (10, 11)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Policy Benchmark 1: Percentage of High-Need Schools with Sealant Programs</strong></td>
</tr>
<tr>
<td>Percentage of high-need schools with sealant programs</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>75-100%</td>
</tr>
<tr>
<td>50-74%</td>
</tr>
<tr>
<td>25-49%</td>
</tr>
<tr>
<td>1-24%</td>
</tr>
<tr>
<td>None</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Policy Benchmark 2: Rules Restricting Hygienists</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>State allows hygienists to provide sealants without a prior dentist’s exam*</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Yes (Exam never required)</td>
</tr>
<tr>
<td>Yes (Exam sometimes required – some classifications of hygienists can place sealants without a prior exam)</td>
</tr>
<tr>
<td>No (Exam always required)</td>
</tr>
<tr>
<td>No (Exam and dentist’s direct or indirect supervision required)</td>
</tr>
</tbody>
</table>

*Response categories changed in 2010
In 2013, Pew Children’s Dental Campaign graded 50 States/DC on four benchmarks focusing on prevention and improving access to sealants among children.(7)

<table>
<thead>
<tr>
<th>Table 2: Pew Center on the States Sealant Policy Benchmarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benchmark 1: Percentage of High-Need Schools with Sealant Programs</strong></td>
</tr>
<tr>
<td><strong>2013 (7)</strong></td>
</tr>
<tr>
<td>Categories</td>
</tr>
<tr>
<td>Programs reaching 75% or more of high-need schools</td>
</tr>
<tr>
<td>Programs reaching 50-74% of high-need schools</td>
</tr>
<tr>
<td>Programs reaching 25-49% of high-need schools</td>
</tr>
<tr>
<td>Programs reaching less than 25% of high-need schools</td>
</tr>
<tr>
<td>No programs</td>
</tr>
</tbody>
</table>

| **Benchmark 2: Rules Restricting Hygienists** |
| Categories |
| A dentist’s exam is not required prior to a hygienist placing a sealant in a school | 15 |
| A dentist’s exam is sometimes required in a school (e.g., certain classifications of dental hygienist, such as public health hygienists, can place sealants without a dentist’s prior exam) | 16 |
| A dentist’s exam is always required in a school | |
| A dentist’s exam and indirect or direct supervision are required in a school | 11 |
| 8 + DC |

| **Benchmark 3: Collecting and Submitting Data to the National Oral Health Surveillance System** |
| Categories |
| Submitted data within the past five years | 31 |
| Participated, but no recent data | 12 |
| Never participated | 7 + DC |

| **Benchmark 4: Meeting Healthy People 2010 Sealant Goal** |
| Categories |
| Met the Sealant goal | 10 |
| Did not meet the Sealant goal | 40 + DC |

| **Overall State Grades** |
| Categories |
| A (10-11 points) | 5 |
| B (8-9 points) | 8 |
| C (6-7 points) | 17 |
| D (3-5 points) | 15 |
| F (0-2 points) | 5 + DC |

C. School-Based Dental Sealant Programs

Health care professionals often provide prevention services in schools to protect and promote the health of students. A school oral health promotion/disease prevention program may incorporate several elements, such as oral health education, dental screenings, topical fluoride and/or sealant applications, and referral for dental treatment. Primary dental care programs in school settings may also include sealants as part of basic restorative and preventive dental treatment. This Best Practice Report will, however, focus only on school-based sealant programs.

School-based dental sealant programs seek to ensure that children receive a highly effective dental prevention service through a proven community-based approach. Tooth decay disproportionately affects low-income children and children from racial and ethnic minority groups.(13) School-based sealant programs generally are designed to maximize effectiveness by targeting schools with high-risk children (those vulnerable populations less likely to receive dental care) such as children eligible for free and reduced-cost meal programs.
Children and their parents/guardians are made aware of the value and the availability of dental sealants through the school program. Once signed consent forms have been returned, children are evaluated for their sealant needs and dental professionals place the sealants. School-based sealant programs address the unmet needs of the children by placing sealants, facilitating referral and ensuring quality and continuity of care through retention checks, replacement of lost sealant material, and follow-up on any untreated dental disease. (14)

A state oral health program's role in school sealant programs may take the form of:
(a) providing direct service delivery,
(b) funding grants or contracts for sealant programs,
(c) managing a state-level program that provides vouchers for services in the community instead of direct services at the school,
(d) assisting with establishment of a "dental home,"
(e) setting standards for local direct service sealant programs, and/or
(f) facilitating and promoting private-public sealant program partnerships (e.g., schools and dental societies).

The following description of a school-based dental sealant program shows the attributes of a direct service delivery program, whether operated by a state or local agency or an organization:

1. Deliver sealants to large numbers of high-risk children with susceptible permanent molar teeth.
   - The program should serve a geographic area that has a critical mass of children who meet its eligibility criteria. Such areas could include urban neighborhoods or rural counties.
   - The goal of the program is to reach children who would be considered high-risk based on their socioeconomic status. Generally, eligibility for the free or reduced cost school meal program from the U.S. Department of Agriculture's National School Lunch Program has been used as a proxy for income and increased risk of untreated decay. Children from low-income families have been shown to be less likely to receive dental care than are children whose families do not meet the meal program criteria. Local standards will determine the acceptability of targeting children rather than schools.
   - In many locales, offering a sealant program only to children on the meal program may be viewed as stigmatizing and, therefore, unacceptable. Targeting schools based on the proportion of free or reduced cost meal program-eligible children, however, is generally acceptable. A minimum of 50 percent of the student enrollment eligible for the free and reduced meals is a common benchmark for school eligibility.
   - Generally, sealant programs target children in the second grade (for sealing the first permanent molars that typically erupt at ages 6 to 7) and sixth grade (for sealing the second permanent molars that typically erupt between 11 and 13 years of age). Targeting these grades maximizes the availability of susceptible molar teeth. Although some sixth graders may not have erupted second molars, this grade was chosen because program participation typically drops off for higher grades.
   - Obtaining signed parental consent forms is a critical component of successful school-based sealant programs. In general, signed consent form return rates are between 40 to 60%. Some of the reasons why parents may not sign consent forms are: a) failure of the child to bring the consent form home or give it to the parents, b) parent’s lack of knowledge about the benefits of dental sealants, c) other health, social, cultural or family factors. To develop an effective program, the program administrators should try to reduce barriers and develop strategies to gain parental consent for students to receive dental sealants.
2. Maximize program efficiency.

- The program staff, in conjunction with school staff, establishes an adequate flow of available children into the sealant placement area. School-based programs minimize the amount of time children are away from class and tend to maximize participation by increasing parent willingness to enroll children in the program.

- The program operates in the least expensive and most productive manner possible, while maintaining quality standards. Sealant delivery with a two-person team using a four-handed technique is more effective than using a single operator. (15)

- On average, efficient school-based programs using four-handed technique can place dental sealants on 15-16 children per team per school day (typical school day is about 6.7 hours). (12) Programs must comply with state laws regarding delegable procedures and whether dentists need to conduct an initial exam to determine which teeth are to be sealed. However, significant cost savings may result from reducing the required level of supervision by a dentist. (12) Efficient use of resources generally directs a program to hire the least expensive qualified personnel permitted to perform the preventive procedures under state law. The program must provide adequate training and quality assurance.

- For any program, choosing the right sealant material is important. The placement of sealant material demands meticulous application techniques and following the manufacturer's instructions. (6) Several sealant materials are available but the most commonly used are resin-based sealants and glass ionomer cements. When selecting the dental sealant material for use in a school-based dental sealant program, the main considerations should include cost-effectiveness of materials that: 1) have prolonged retention properties; 2) have low solubility in the oral environment; and 3) are simple to apply. (14)

3. Maintain a quality assurance system.

- Patient/family procedures. A quality sealant program ensures confidentiality and treats children and families respectfully. A quality program should have direct communication with the parent/guardian of the child. Sealants will not be placed without written permission and a completed medical form. The program will provide the family with documentation of services provided.

- Clinical procedures. A quality program will follow Centers for Disease Control and Prevention (CDC) infection control guidelines and the Occupational Safety and Health Administration (OSHA) guidelines and standards to promote worker safety and health with written policies and protocols in place. The program will stay abreast of the latest evidence-based studies focused on dental sealants, sealant material, and application techniques.

- Family Educational Right and Privacy Act/Health Insurance Portability and Accountability Act (FERPA/HIPAA). Programs will be in compliance with laws that are in place to protect the privacy of student information. For more information: National Assn. of School Nurses: HIPAA & FERPA.

- Quality Assurance. Technical quality generally refers to a high rate of retention for sealants (one-year retention rates of well-applied sealants usually averages between 80 to 90%). Sealant quality can be assessed by checking short-term retention rates or one-year retention rates or both on a sample of students who received dental sealants from the SBSP. Short term retention checks are done within one to two months of sealant placement and are helpful to evaluate staff performance, to identify needed protocol changes, and to determine the adequacy of material and equipment used. (14) Yearly retention checks are generally done during the next school year. If resources allow then retention checks should be completed on as many students as possible.
o Ensuring Appropriateness of the Program. Appropriateness can be evaluated by analyzing program participation to ensure children and schools in the program meet its eligibility criteria. Additionally, programs should ensure compliance with applicable state laws and professional standards and guidelines, including infection control.

4. Identify children with treatment needs and ensure that they receive appropriate dental care.

o When assessing the need for sealants, programs typically also identify children with treatment needs such as untreated decay and notify parents/guardians and school nurses. Ensuring that children receive appropriate dental care often is the most difficult aspect of a school-based sealant program. Ideally treatment needs will be met through linking a child to a dental home, which could include a broad base of locations, such as private dental providers, local health departments, non-profit public clinics, and community health centers.

o School-based dental professionals and community health workers can play an important role in helping to coordinate needed dental care and address potential barriers that interfere with parents pursuing care, finding dentists who will provide care to their children and assuring that children receive the recommended care.

5. Re-screen children within one year of initial sealant placement.

o Sealant retention and integrity can be checked and newly erupted teeth can be sealed during the following school year if the child has not moved and if consent is received. Typically, children who received sealants in second grade are re-screened in third grade. Best practices guidelines recommend sealant retention checks to be performed within one year of sealant placement.

o The timing of sealant retention evaluation can depend on several factors such as local program objectives; changes in dental materials, techniques or personnel; and student movement in and out of the school and school district.(8)

o Evaluating sealants after placement is very important but may not be feasible for all programs. However, even if the follow-up cannot be ensured, high-risk children should still receive sealants.(6)

6. Maintain descriptive program data.

Program data should reflect the program’s ability to reach its goals and objectives. Baseline data should be established to track progress towards program goals.

Descriptive program data may include:

o An estimate of the percentage of eligible schools (e.g., schools with 50 percent or more of the students eligible for the free and reduced lunch program) in the state served by sealant programs (generally each state’s Department of Education website has the list of public schools with percentage of children on free and reduced lunch program). National statistics on distribution of public schools by free and reduced lunch program can be found on the National Center for Education Statistics website.

o An estimate of the number and percentage of all high-risk children in the state who receive sealants through the program.

o Number of consent forms returned.

o Rates of participation. Number of children screened and number of children who received sealants.
- Calculating and comparing caries incidence (new areas of tooth decay) in children who participated in the sealant program and received sealants. For example, comparing cohort data from 2012 to 2013.

- An estimate of the cost per child screened (including costs of referrals for care) and cost per child who receives sealants. These will provide suitable benchmarks for program efficiency. (16, 17) Methods used by states to estimate cost per child or per sealant are not standardized (e.g., cost of equipment, sealant supplies and materials, travel and/or administrative time may or may not be included in estimating cost). Note that depending on the tooth selection criteria, assessment of the number of teeth sealed or the cost per tooth sealed should identify if low-risk teeth, such as premolars, routinely were also sealed.

One option for maintaining sealant program data is SEALS (Sealant Efficiency Assessment for Locals and States), a software program developed by the Centers for Disease Control and Prevention (CDC) that aids in the evaluation of sealant program effectiveness and efficiency. This Excel-based software automates the capture, storage, and analysis of oral health status of participants, the type and number of delivered services, and event costs and logistics. SEALS generate summaries and performance measures such as cost per child receiving sealants, sealant retention, averted caries, and children sealed per chair-hour. Companion software, SEALS_Admin, uses data from individual local sealant programs to calculate statewide values of the summary and performance measures and ranks individual programs on 15 performance measures. SEALS data can be used to estimate the cost and impact of a sealant program. Data also can be used to compare school sealant events by need, cost and efficiency, enabling programs to allocate resources more efficiently. The software can help programs identify areas where they are less efficient and then set goals for improvement.

7. Sustainability.

The program’s sustainability can be demonstrated by having an ongoing plan for covering program expenses. This may include a recurring line item in the state or municipal budget, a mechanism for collecting Medicaid reimbursements, or recurring grant funding. Some state agencies may enter into creative partnerships with community groups or funders to sustain the program.

II. Objectives, Guidelines & Recommendations from Authoritative Sources

<table>
<thead>
<tr>
<th>Objective</th>
<th>Baseline*</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>12.1:</strong> Increase the proportion of children aged 3-5 years who have received dental sealants on one or more of their primary molar teeth</td>
<td>1.4 % of children aged 3-5 years received dental sealants on one or more of their primary molars in 1999–2004</td>
<td>1.5%</td>
</tr>
<tr>
<td><strong>12.2:</strong> Increase the proportion of children aged 6-9 years who have received dental sealants on one or more of their permanent first molar teeth</td>
<td>25.5 % of children aged 6-9 years received dental sealants on one or more of their first permanent molars in 1999–2004</td>
<td>28.1%</td>
</tr>
<tr>
<td><strong>12.3:</strong> Increase the proportion of adolescents aged 13-15 years who have received dental sealants on one or more of their permanent molar teeth</td>
<td>19.9 % of adolescents aged 13-15 years received dental sealants on one or more of their first permanent molars and one or more second permanent molars in 1999–2004</td>
<td>21.9 %</td>
</tr>
</tbody>
</table>

*Data Source: National Health and Nutrition Examination Survey (NHANES), CDC, NCHS (13)
Sealant programs focus on permanent molars because caries risk on other teeth with pits and fissures is considerably lower.(3) Although sealants can be placed on the pits and fissures of children’s premolars, maxillary incisors and primary molars, the situations in which such use would be appropriate may be limited.

**Guidelines and Recommendations:** In 2009, CDC and a workgroup of recognized experts in sealant research, practice, and policy, and experts in caries assessment, prevention, and treatment published guidelines for sealant use in school-based programs.(8) These guidelines are based on current scientific evidence and provide guidance in planning, implementing and evaluating school-based sealant programs (Table 4).

<table>
<thead>
<tr>
<th>Topic</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indications for sealant placement</strong></td>
<td>Seal sound and non-cavitated pit and fissure surfaces of posterior teeth, with first and second permanent molars receiving highest priority.</td>
</tr>
<tr>
<td><strong>Tooth surface assessment</strong></td>
<td>Differentiate cavitated and non-cavitated lesions.</td>
</tr>
<tr>
<td></td>
<td>• Unaided visual assessment is appropriate and adequate.</td>
</tr>
<tr>
<td></td>
<td>• Dry teeth prior to assessment with cotton rolls, gauze, or, when available, compressed air.</td>
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<tr>
<td></td>
<td>• An explorer may be used to “gently” confirm cavitation (i.e., breaks in the continuity of the surface); do not use a sharp explorer under force.</td>
</tr>
<tr>
<td></td>
<td>• Radiographs are unnecessary solely for sealant placement.</td>
</tr>
<tr>
<td></td>
<td>• Other diagnostic technologies are not required.</td>
</tr>
<tr>
<td><strong>Sealant placement and evaluation</strong></td>
<td>Clean the tooth surface.</td>
</tr>
<tr>
<td></td>
<td>• Toothbrush prophylaxis can be used.</td>
</tr>
<tr>
<td></td>
<td>• Additional surface preparation methods, such as air abrasion or enameloplasty, are not recommended.</td>
</tr>
<tr>
<td></td>
<td>• Use a four-handed technique, when resources allow.</td>
</tr>
<tr>
<td></td>
<td>• Seal teeth of children even if follow-up cannot be ensured.</td>
</tr>
<tr>
<td></td>
<td>• Evaluate sealant retention within one year.</td>
</tr>
</tbody>
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**III. Research Evidence**

The Community Preventive Services Task Force recommends school-based dental sealant programs based on strong evidence of effectiveness in preventing caries in children.(6) A 2013 Cochrane Collaboration review of sealant studies found that sealant placement on the occlusal surfaces of the permanent molars in children and adolescents reduces caries by 81% when compared to no sealant when followed up to two years.(6, 19)

The Community Guide (2013) found that the adjusted median decrease in caries on the occlusal surfaces of posterior teeth in children due to sealant placement was 40%. School-based sealant programs become more cost-effective as the caries risk of the targeted students increases. (20-22) For programs targeting high-risk schools, sealing all children offers higher cost-savings than trying to identify and seal only high-risk children.(23) In schools where as few as 20% of students are high-risk, delivering sealants to all children improves oral health outcomes at a small cost (8 cents per cavity-free month per tooth).(24) School-based sealant programs can also reduce racial, ethnic and economic disparities in the prevalence of dental sealants.(8, 25)
IV. Best Practice Criteria

For the best practice approach of School-based Dental Sealant Programs, the ASTDD Best Practices Committee has proposed the following initial review standards for five best practice criteria:

1. Impact/Effectiveness:
   - The program delivers services to large numbers of high-risk children with susceptible permanent molar teeth.
   - The program maintains a quality assurance system that includes technical quality (the sealants placed have a high rate of retention) and appropriateness (the children receiving sealants are at high caries risk).

2. Efficiency:
   - The program uses the least expensive personnel permitted by state laws to screen children and deliver dental sealants with adequate training and quality assurance.

3. Demonstrated Sustainability:
   - The program demonstrates sustainability by establishing a track record or a reasonable plan for covering program expenses.

4. Collaboration/Integration:
   - Collaborative partnerships are established to administer and sustain the program.

5. Objectives/Rationale:
   - The program’s goals and objectives are linked to the state and/or national oral health goals and objectives.

V. State Practice Examples

During the first phase of the ASTDD Best Practices Project, states submitted descriptions of their successful practices to share their experiences and implementation strategies. The following practice examples illustrate various elements or dimensions of the best practice approach for School-based Dental Sealant Programs. These reported success stories should be viewed in the context of the individual state and program environment, infrastructure and resources. End-users are encouraged to review the practice descriptions (click on the links of the practice names) and adapt ideas for a better fit to their states and programs.

A. Summary Listing of Practice Examples

In FY 2013-2014, five states updated practice descriptions of their school-based dental sealant programs to the ASTDD Best Practices Committee and six states provided new submissions. These programs illustrate substantial elements of the model school-based sealant program described in Section I-C. See Figure 1. Each practice name is linked to a detailed description report.
### State Practice Examples of School-based Dental Sealant Programs

<table>
<thead>
<tr>
<th>Item</th>
<th>Practice Name</th>
<th>State</th>
<th>Practice #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Arizona Dental Sealant Program</td>
<td>AZ</td>
<td>04006</td>
</tr>
<tr>
<td>2</td>
<td>Cost Study of Colorado School-based Dental Sealant Programs</td>
<td>CO</td>
<td>07005</td>
</tr>
<tr>
<td>3</td>
<td>Georgia’s State School-based Dental Sealant Program</td>
<td>GA</td>
<td>12006</td>
</tr>
<tr>
<td>4</td>
<td>Illinois Dental Sealant Grant Program</td>
<td>IL</td>
<td>16004</td>
</tr>
<tr>
<td>5</td>
<td>Kansas School Oral Health Programs</td>
<td>KS</td>
<td>19014</td>
</tr>
<tr>
<td>6</td>
<td>SEAL! Michigan School-based Dental Sealant Program</td>
<td>MI</td>
<td>25007</td>
</tr>
<tr>
<td>7</td>
<td>Southern Nevada Dental Initiative-Future Smiles School-based Prevention Program</td>
<td>NV</td>
<td>31008</td>
</tr>
<tr>
<td>8</td>
<td>New Mexico School-linked Dental Sealant Program</td>
<td>NM</td>
<td>34001</td>
</tr>
<tr>
<td>9</td>
<td>The Ohio Department of Health Dental School-based Sealant Program</td>
<td>OH</td>
<td>38002</td>
</tr>
<tr>
<td>10</td>
<td>Oregon School-based Dental Sealant Program</td>
<td>OR</td>
<td>40007</td>
</tr>
<tr>
<td>11</td>
<td>Wisconsin Seal-A-Smile</td>
<td>WI</td>
<td>56004</td>
</tr>
</tbody>
</table>

### B. Highlights of Practice Examples

**AZ**  **Arizona Dental Sealant Program** (Practice #04006)
The Arizona Department of Health, Bureau of Women’s and Children’s Health, Office of Oral Health has administered the Arizona Dental Sealant Program since 1987. This school-based dental sealant program targets children in 2nd and 6th grades attending eligible schools in Arizona. Eligible schools are public and charter schools with a high proportion of students participating in the National School Lunch Program (free and reduced lunch program). All children in 2nd and 6th grade attending eligible schools are entitled to receive a dental screening; those who are uninsured, Medicaid and SCHIP beneficiaries, covered by Indian Health Services or by a state-funded primary care health care program and do not have private dental insurance also qualify for dental sealants. Counties and individual providers are contracted by the state Office of Oral Health to implement the program.

**CO**  **Cost Study of Colorado School-based Dental Sealant Programs** (Practice #07005)
The Cost Study of Colorado School-based Sealant Programs (SBSP) was designed to analyze existing SBSP utilization data, recorded in the using the Sealant Efficiency Assessment for Locals
and States (SEALS) software, collect and analyze SBSP cost information, and use the SEALS and cost data to develop an economic model to estimate potential cost savings associated with SBSP implementation during the 2010-2011 academic year. Researchers from the Colorado School of Public Health at the University of Colorado Denver conducted the work. The project totaled $97,855 and the work was conducted over a 20.5 month period (4/15/2010 - 12/31/2011). The funding included indirect costs billed as part of the university contract.

GA **Georgia’s State School-based Dental Sealant Program** (Practice #12006)
The Georgia dental sealant program is a school-based program designed to provide eligible students with dental sealants on their first and second permanent molars to prevent tooth decay. The Georgia Third Grade Oral Health BSS, in 2011, found 52% of 3rd grade children in Georgia have a history of tooth decay; 19% have untreated tooth decay; only 37% of 3rd grade children in GA have protective sealants on their 1st permanent molars. The Georgia Oral Health Prevention Program (GOHPP) provides funds to support the School-Based Sealant Program (S-BSP) targeting high-risk schools, those with large proportions of students from families with low-income. In 2009, 45 of the state’s sealant programs were funded by the GOHPP and approximately 3000 sealants were placed on schoolchildren. The GOHPP funds originated from the Maternal and Child Health Block (MCHB) grant as well as state general funds.

IL **Illinois Dental Sealant Grant Program** (Practice #16004)
The **Dental Sealant Grant Program** (DSGP) assists Illinois schoolchildren who are most at risk for dental caries by providing granting funds, technical assistance and training to public health departments and to other service providers to develop and to implement community-based oral health programs. This school-based/linked program includes: preventive oral health care, oral health education and case management to dental homes. It has been the catalyst for expanding community-based oral health programs throughout the state. It is an essential component to a continuum of oral health care focusing on children and their families who are at the most risk for dental disease. In FY 13, the DSGP currently exists in 72 of the 102 counties in the state and serves approximately 180,000 children placing over 400,000 sealants annually. Since the program’s inception in 1986, there more than 1 million children have been seen and more than 2 million sealants placed.

KS **Kansas School Oral Health Programs** (Kansas School Screening Program and Kansas School Sealant Program) (Practice #19014)
Kansas has two school oral health programs, the Kansas School Screening Program and the Kansas School Sealant Program, that are administered by the Bureau of Oral Health (BOH). The state has a law that requires each child to have an annual “dental inspection.” In 2007 the Bureau of Oral Health received a state foundation grant to create a standardized screening protocol and an online data collection system. The protocol mimics the Basic Screening Survey and uses volunteer dental professional screeners to collect and input the screening data. The Screening Program provides the Bureau with school, county and statewide data on children K-12. In the 2011-2012 school year the Screening Program was in 46% of all Kansas public schools. A searchable database of the oral health data is publically available at the Bureau’s website.

MI **SEAL! Michigan School-Based Dental Sealant Program** (Practice #25007)
The Michigan Department of Community Health’s SEAL! Michigan dental sealant program works to prevent dental disease through prevention. SEAL! Michigan provides dental sealants, fluoride varnish, and oral health education to students in Michigan in their school settings. By utilizing Registered Dental Hygienists who travel to schools to provide prevention services onsite, cost saving is realized. The SEAL! Michigan program delivers dental sealants, fluoride varnish, and oral health education to children for less than $100 per student. Since the inception of the dental sealant program in 2007, thousands of children have received dental sealants. For the 2009-2010 school year, the program served 85 schools, screened 3,029 students and 214 students with special needs, and provided 11,426 sealants to 1,853 students. Surveys in 2006 and 2010 showed an increased in percentage of 3rd grade children with dental sealants, from 23.3% to 26.4%, closer to reaching the Healthy People 2020 target of 28.1%.
NV **Southern Nevada Dental Initiative – Future Smiles School-based Prevention Program** (Practice #31008)

Future Smiles is a Nevada non-profit, 501(c) (3) IRS status, school-based prevention program that provides services to children who attend higher-risk schools with greater than 50% free and reduced meal program enrollment (FRL). Children served by the program are from families living well below the federal poverty guidelines (FPL), Medicaid/CHIP enrollees as well as children who are uninsured/underinsured living in Southern Nevada. All at-risk children enrolled at the schools are eligible for services.

NM **School Based Dental Sealant Program** (Practice #34001)

The New Mexico Department of Health (DOH), Office of Oral Health (OOH) administers a school-based dental sealant program that provides oral health education, dental screenings, and dental sealant applications on first and second molars. The dental sealant program was developed to provide preventive services for school children to reduce tooth decay, since many low-income children have limited or no access to preventive dental care. In rural areas, all elementary school children are eligible to participate in the dental sealant program. In urban areas, the services are limited to the first, second and third grade students. The program is supported by state staff and by contracted private dental providers. Program services are offered at no cost to the parents or guardians and to participating schools. Elementary schools qualify for the program if they have at least 50% or more of its student population on the free and reduced school lunch program. FY 12 the State of New Mexico allocated an estimated $681,499.00 general fund for the state dental sealant program. For the 2012 school year: 6,254 students participated in the program with a total of 19,075 molars being sealed.

OH **The Ohio Department of Health Dental School-Based Sealant Program** (Practice #38002)

The Ohio Department of Health’s (ODH) School-based Oral Health Program provides grants to support school-based sealant programs (SBSPs) targeting higher-risk schools, those with large proportions of students from families with low-incomes. In 2012, 18 of the state’s 21 SBSPs were funded by ODH and provided sealants to 25,321 schoolchildren. The ODH grant funds originate from Ohio’s Federal Maternal and Child Health (MCH) Block Grant. In 2010, a HRSA Oral Health Workforce grant supported the expansion of SBSPs. Grantee agencies include: local health departments, school systems, private not-for-profit agencies, and hospitals. Findings from the ODH’s 2009-10 oral health survey of schoolchildren indicate that SBSPs, targeted to groups at higher-risk for dental caries and least likely to receive regular dental care have substantially increased sealant prevalence and reduced disparity in schools reached by the program. The prevalence of sealants among third grade students in schools with dental sealant programs is approximately 1.5 times greater than for students in schools without sealant programs. Just over 50 percent of all Ohio third graders have at least one or more sealants on their permanent molar teeth, meeting the HP2010 objective regardless of racial group or income. In 2013, the ODH began implementing a pilot collaboration between two safety net dental care programs and SBSPs in Northeast Ohio to provide follow-up care to students identified as needing dental treatment. As part of the ODH Quality Assurance Plan, the ODH initiated formalized biennial “check-in” calls to discuss with SBSPs their progress toward meeting ODH benchmarks and their sealant targets for the year.

OR **Oregon School-based Dental Sealant Program** (Practice #40007)

The Oregon Health Authority’s (OHA’s) Dental Sealant Program (DSP) targets schools where at least 50% of the students are eligible for the Federal Free-and-Reduced Lunch Program. In the participating schools, all 1st and 2nd graders with parent permission receive a screening, and sealants are placed when appropriate (1st-5th graders in very small schools). Children with immediate dental needs are referred for care through coordination with the school nurse. Local resources such as Coordinated Care Organizations (Oregon’s Medicaid program), Dental Care Organizations, and community health clinics that offer dental services are utilized.
VI. Acknowledgements

This updated report is the result of efforts by ASTDD to identify and provide information on developing successful practices that address the oral health care needs of infants, toddlers and preschool children.

The ASTDD Best Practices Committee extends a special thank you to Dr. Shillpa Naavaal, BDS, MPH, MS, Dental Public Health Resident at CDC (2012-2013), for her help in preparation of this report.

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VII. Attachment

Strength of Evidence Supporting Best Practice Approaches

The ASTDD Best Practices Committee takes a broad view of evidence to support best practice approaches for building effective state and community oral health programs. The Committee evaluated evidence in four categories: research, expert opinion, field lessons and theoretical rationale. Although all best practice approaches reported have a strong theoretical rationale, the strength of evidence from research, expert opinion and field lessons fall within a spectrum. On one end of the spectrum are *promising best practice approaches*, which may be supported by little research, a beginning of agreement in expert opinion, and very few field lessons evaluating effectiveness. On the other end of the spectrum are *proven best practice approaches*, ones that are supported by strong research, extensive expert opinion from multiple authoritative sources, and solid field lessons evaluating effectiveness.

<table>
<thead>
<tr>
<th>Promising Best Practice Approaches</th>
<th>Proven Best Practice Approaches</th>
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<tr>
<td>Research</td>
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<td>Expert Opinion</td>
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<td>Field Lessons</td>
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<tr>
<td>Theoretical Rationale</td>
<td>Theoretical Rationale</td>
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Research
- + A few studies in dental public health or other disciplines reporting effectiveness.
- ++ Descriptive review of scientific literature supporting effectiveness.
- +++ Systematic review of scientific literature supporting effectiveness.

Expert Opinion
- + An expert group or general professional opinion supporting the practice.
- ++ One authoritative source (such as a national organization or agency) supporting the practice.
- +++ Multiple authoritative sources (including national organizations, agencies or initiatives) supporting the practice.

Field Lessons
- + Successes in state practices reported without evaluation documenting effectiveness.
- ++ Evaluation by a few states separately documenting effectiveness.
- +++ Cluster evaluation of several states (group evaluation) documenting effectiveness.

Theoretical Rationale
- +++ Only practices which are linked by strong causal reasoning to the desired outcome of improving oral health and total well-being of priority populations will be reported on this website.
VIII. Resources

1) Seal America
2) CDC School-Based Dental Sealant Programs
3) NIDCR- Sealants
4) Arkansas PANDA Program
6) Ohio – School-Based Dental Sealant Program Manual
7) OSAP- Portable and Mobile Oral Health Settings References and Resources
8) Confidentiality in School-Based Health Services: Understanding HIPAA & FERPA
9) DHHS & Dept. of Education: FERPA & HIPAA
10) ADA- Pit-and-Fissure Sealants
11) CDHP- Dental Sealants: Proven to Prevent Tooth Decay

IX. References


Problem
Pit-and-fissure sealants have been used effectively as part of a comprehensive approach to caries prevention for children and adults on an individual basis or as a public health measure for at-risk populations.\textsuperscript{1} Bisphenol A (BPA), a chemical used to manufacture polycarbonate plastics and found in many food and drink containers as well as dental sealant and composite resin materials, may cause some adverse health effects such as problems with reproduction and development.\textsuperscript{2} A recent systematic review examining the existence of BPA in dental materials and its relationship to any potential health risks recommends continued use of these dental products for children, with firm adherence to precautionary application techniques.\textsuperscript{3} However, the same systematic review, advises pregnant women to defer elective dental treatment with composite and sealants. The American Dental Association (ADA) and experts from the American Academy of Pediatric Dentistry (AAPD) reviewed the evidence and concluded that dental sealants should still be recommended for all populations because the purported risks were minimal and could be controlled by routine operative procedures.

Methods
Placement of resin-based sealants on the permanent molars of children is effective for caries reduction.\textsuperscript{4} Sealants can be used in primary prevention\textsuperscript{5} or secondary prevention of dental caries.\textsuperscript{6} Working with partners at local and state levels, school-based sealant programs help students with limited access to dental care receive dental services. Those programs are recommended on the basis of strong evidence of effectiveness in reducing caries on occlusal surfaces of posterior teeth among children.\textsuperscript{1}

Resins in sealants and composites are composed primarily of BPA derivatives rather than pure BPA.\textsuperscript{3} BPA may be released from dental resins in sealants and composites through salivary enzymatic hydrolysis of BPA derivatives, and BPA is detectable in small amounts in saliva for up to three hours after resin placement.\textsuperscript{3} However, this finding was not consistent among all studies; other in-vitro studies failed to detect any traces of BPA derivatives over a period of ten days.\textsuperscript{7,8,9} The quantity and duration of systemic BPA absorption from dental resins is not clear from the available data.\textsuperscript{3} However, the amount of the dental sealant material usually used in children does not influence the serum concentration levels of BPA.\textsuperscript{10}

Dental sealant and composite product selection is important since dental resin materials contain different molecular formulations that determine the release of BPA. Dental products containing the bisphenol A derivative glycidyl dimethacrylate (bis-GMA) are less likely to be hydrolyzed to BPA so there is less risk of BPA absorption and subsequent possible adverse health effects than those containing bisphenol A.
dimethacrylate (bis-DMA). Studies have consistently shown that bis-DMA hydrolyzes to BPA on contact with salivary esterases. This process does not occur with bis-GMA making bis-GMA based resins preferable in terms of adverse health effects rather than bis-DMA based products.

Bis-GMA-based resins seem to be used most commonly in the U.S. market according to a listing of products with the greatest market share and the monomer compositions listed on current material safety data sheets (MSDSs). Most other BPA derivatives used in dental materials have not been evaluated for adverse health effects.

The literature suggests the following simple precautionary application techniques that can be used to considerably reduce BPA exposure:

- Adequate light curing that incorporates a longer curing time with lower intensity lights results in less cytotoxicity and less release of the unpolymerized components,
- Rinsing the mouth for about 30 seconds following application of a dental sealant with water or saline solution or rubbing the sealant using a mild abrasive such as pumice, either on a cotton applicator or a prophylaxis cup is suggested to be effective in minimizing the monomers release, and,
- Further, temporarily blocking off the sealed area with a rubber dental dam also helps in minimizing the leach of the monomers to the saliva.

The ADA and key government agencies concur that there is a lack of evidence and toxicological information demonstrating that the low-level of BPA exposure that may result from dental sealants and composites poses any known health threat. The Department of Health and Human and Services considers population exposure to BPA from dental sealants low and infrequent. In addition, the Food and Drug Administration (FDA) asserts that FDA-regulated products on the market that contain BPA are safe.

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Policy Statement

The Association of State and Territorial Dental Directors supports and recommends the continued use of composites and dental sealants for all populations.

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Note to Readers

This document is a summary guide of basic infection prevention recommendations for all dental health care settings. These include traditional settings such as private dental practices, dental clinics, dental schools and educational programs (including dental assisting, dental hygiene, and laboratory) and nontraditional settings that often use portable dental equipment such as clinics held in schools for sealant and fluoride placement and in other sites for humanitarian dental missions.

While the information included in this document reflects existing evidence-based guidelines produced by the Centers for Disease Control and Prevention (CDC), it is not intended as a replacement for more extensive guidelines. This summary guide is based primarily upon elements of Standard Precautions and represents a summary of basic infection prevention expectations for safe care in dental settings as recommended in the Guidelines for Infection Control in Dental Health-Care Settings—2003. Readers are urged to use the Infection Prevention Checklist for Dental Settings (Appendix A), a companion to the summary; and to consult the full guidelines for additional background, rationale, and scientific evidence behind each recommendation.

Suggested Citation


Introduction

Transmission of infectious agents among patients and dental health care personnel (DHCP) in dental settings is rare. However, from 2003 to 2015, transmissions in dental settings, including patient-to-patient transmissions, have been documented.\(^1\)\(^-\)\(^4\) In most cases, investigators failed to link a specific lapse of infection prevention and control with a particular transmission. However, reported breakdowns in basic infection prevention procedures included unsafe injection practices, failure to heat sterilize dental handpieces between patients, and failure to monitor (e.g., conduct spore testing) autoclaves.\(^2\)\(^,\)\(^3\) These reports highlight the need for comprehensive training to improve understanding of underlying principles, recommended practices, their implementation, and the conditions that have to be met for disease transmission.

All dental settings, regardless of the level of care provided, must make infection prevention a priority and should be equipped to observe Standard Precautions and other infection prevention recommendations contained in CDC’s Guidelines for Infection Control in Dental Health-Care Settings—2003.\(^5\) The Summary of Infection Prevention Practices in Dental Settings: Basic Expectations for Safe Care summarizes current infection prevention recommendations and includes a checklist (Appendix A) that can be used to evaluate compliance.

The information presented here is based primarily upon the recommendations from the 2003 guideline and represents infection prevention expectations for safe care in dental settings. It is intended for use by anyone needing information about basic infection prevention measures in dental health care settings, but is not a replacement for the more extensive guidelines. Readers are urged to consult the full guidelines for additional background, rationale, and scientific evidence behind each recommendation. Additional topics and information relevant to dental infection prevention and control published by CDC since 2003 in this document can be found in Appendix B including:

- Infection prevention program administrative measures.
- Infection prevention education and training.
- Respiratory hygiene and cough etiquette.
- Updated safe injection practices.
- Administrative measures for instrument processing.

For the purposes of this document, DHCP refers to all paid and unpaid personnel in the dental health care setting who might be occupationally exposed to infectious materials, including body substances and contaminated supplies, equipment, environmental surfaces, water, or air. This includes:

- Dentists.
- Dental hygienists.
- Dental assistants.
- Dental laboratory technicians (in-office and commercial).
- Students and trainees.
- Contractual personnel.
- Other persons not directly involved in patient care but potentially exposed to infectious agents (e.g., administrative, clerical, housekeeping, maintenance, or volunteer personnel).\(^5\)
Objectives

By highlighting existing CDC recommendations, this summary guide
1. Provides basic infection prevention principles and recommendations for dental health care settings.
2. Reaffirms Standard Precautions as the foundation for preventing transmission of infectious agents during patient care in all dental health care settings.
3. Provides links to full guidelines and source documents that readers can reference for more detailed background and recommendations.

For additional references, background information, rationale, and evidence, readers should consult the references and resources listed in Appendix C. Detailed recommendations for dental health care settings can be found in the compendium document, Recommendations from the Guidelines for Infection Control in Dental Health-Care Settings—2003.

References

Fundamental Elements Needed to Prevent Transmission of Infectious Agents in Dental Settings

Administrative Measures

Infection prevention must be made a priority in any dental health care setting. At least one individual with training in infection prevention—the infection prevention coordinator—should be responsible for developing written infection prevention policies and procedures based on evidence-based guidelines, regulations, or standards. Policies and procedures should be tailored to the dental setting and reassessed on a regular basis (e.g., annually) or according to state or federal requirements. Development should take into consideration the types of services provided by DHCP and the patient population served, extending beyond the Occupational Safety and Health Administration (OSHA) bloodborne pathogens standard to address patient safety. The infection prevention coordinator should ensure that equipment and supplies (e.g., hand hygiene products, safer devices to reduce percutaneous injuries, and personal protective equipment) are available and should maintain communication with all staff members to address specific issues or concerns related to infection prevention. In addition, all dental settings should have policies and protocols for early detection and management of potentially infectious persons at initial points of patient encounter.

Key ADMINISTRATIVE RECOMMENDATIONS for Dental Settings

1. Develop and maintain infection prevention and occupational health programs.
2. Provide supplies necessary for adherence to Standard Precautions (e.g., hand hygiene products, safer devices to reduce percutaneous injuries, personal protective equipment).
3. Assign at least one individual trained in infection prevention responsibility for coordinating the program.
4. Develop and maintain written infection prevention policies and procedures appropriate for the services provided by the facility and based on evidence-based guidelines, regulations, or standards.
5. Facility has system for early detection and management of potentially infectious persons at initial points of patient encounter.

Infection Prevention Education and Training

Ongoing education and training of DHCP are critical for ensuring that infection prevention policies and procedures are understood and followed. Education on the basic principles and practices for preventing the spread of infections should be provided to all DHCP. Training should include both DHCP safety (e.g., OSHA bloodborne pathogens training) and patient safety (e.g., emphasizing job- or task-specific needs). Education and training should be provided during orientation to the setting, when new tasks or procedures are introduced and at a minimum, annually. Training records should be maintained according to state and federal requirements.
Key Recommendations for EDUCATION AND TRAINING in Dental Settings

1. Provide job- or task-specific infection prevention education and training to all DHCP.
   a. This includes those employed by outside agencies and available by contract or on a volunteer basis to the facility.

2. Provide training on principles of both DHCP safety and patient safety.

3. Provide training during orientation and at regular intervals (e.g., annually).

4. Maintain training records according to state and federal requirements.

Dental Health Care Personnel Safety

Infection prevention programs should also address occupational health needs, including vaccination of DHCP, management of exposures or infections in personnel requiring post-exposure prophylaxis or work restrictions, and compliance with OSHA bloodborne pathogens standard. Referral arrangements for medical services can be made with qualified health care professionals in an occupational health program of a hospital, with educational institutions, or with health care facilities that offer personnel health services.

Recommendations for prevention of infections in DHCP can be found in the following documents—

Key Recommendations for DENTAL HEALTH CARE PERSONNEL SAFETY

1. Current CDC recommendations for immunizations, evaluation, and follow-up are available. There is a written policy regarding immunizing DHCP, including a list of all required and recommended immunizations for DHCP (e.g., hepatitis B, MMR (measles, mumps, and rubella) varicella (chickenpox), Tdap (tetanus, diphtheria, pertussis).

2. All DHCP are screened for tuberculosis (TB) upon hire regardless of the risk classification of the setting.

3. Referral arrangements are in place to qualified health care professionals (e.g., occupational health program of a hospital, educational institutions, health care facilities that offer personnel health services) to ensure prompt and appropriate provision of preventive services, occupationally-related medical services, and postexposure management with medical follow-up.

4. Facility has well-defined policies concerning contact of personnel with patients when personnel have potentially transmissible conditions.
Program Evaluation

A successful infection prevention program depends on:
- Developing standard operating procedures.
- Evaluating practices and providing feedback to DHCP.
- Routinely documenting adverse outcomes (e.g., occupational exposures to blood) and work-related illnesses in DHCP.
- Monitoring health care associated infections in patients.

Strategies and tools to evaluate the infection prevention program can include periodic observational assessments, checklists to document procedures, and routine review of occupational exposures to bloodborne pathogens. The Infection Prevention Checklist for Dental Settings found in Appendix A is one tool DHCP can use to evaluate their infection prevention program. Evaluation offers an opportunity to improve the effectiveness of both the infection-prevention program and dental practice protocols. If deficiencies or problems in the implementation of infection prevention procedures are identified—further evaluation and feedback, corrective action, and training (if applicable) is needed to eliminate the problems.

Key Recommendation for PROGRAM EVALUATION in Dental Settings

1. Establish routine evaluation of the infection prevention program, including evaluation of DHCP adherence to infection prevention practices.

Standard Precautions

Standard Precautions are the minimum infection prevention practices that apply to all patient care, regardless of suspected or confirmed infection status of the patient, in any setting where health care is delivered. These practices are designed to both protect DHCP and prevent DHCP from spreading infections among patients. Standard Precautions include—

1. Hand hygiene.
2. Use of personal protective equipment (e.g., gloves, masks, eyewear).
3. Respiratory hygiene/cough etiquette.
4. Sharps safety (engineering and work practice controls).
5. Safe injection practices (i.e., aseptic technique for parenteral medications).
7. Clean and disinfected environmental surfaces.

Each element of Standard Precautions is described in the following sections. Education and training are critical elements of Standard Precautions, because they help DHCP make appropriate decisions and comply with recommended practices.

When Standard Precautions alone cannot prevent transmission, they are supplemented with Transmission-Based Precautions. This second tier of infection prevention is used when patients have diseases that can spread through contact, droplet or airborne routes (e.g., skin contact, sneezing, coughing) and are always used in addition to Standard Precautions. Dental settings are not typically designed to carry out all of the Transmission-Based Precautions (e.g., Airborne Precautions for patients with suspected tuberculosis, measles, or chickenpox) that are recommended for hospital and other ambulatory care settings. Patients, however, do not usually seek routine dental outpatient care when acutely ill with diseases requiring Transmission-Based Precautions. Nonetheless, DHCP should develop and carry out systems for early detection and management of
potentially infectious patients at initial points of entry to the dental setting. To the extent possible, this includes rescheduling non-urgent dental care until the patient is no longer infectious or referral to a dental setting with appropriate infection prevention precautions when urgent dental treatment is needed.

**Hand Hygiene**

Hand hygiene is the most important measure to prevent the spread of infections among patients and DHCP. Education and training programs should thoroughly address indications and techniques for hand hygiene practices before performing routine and oral surgical procedures.

For routine dental examinations and nonsurgical procedures, use water and plain soap (hand washing) or antimicrobial soap (hand antisepsis) specific for health care settings or use an alcohol-based hand rub. Although alcohol-based hand rubs are effective for hand hygiene in health care settings, soap and water should be used when hands are visibly soiled (e.g., dirt, blood, body fluids). For surgical procedures, perform a surgical hand scrub before putting on sterile surgeon’s gloves. For all types of hand hygiene products, follow the product manufacturer’s label for instructions. Complete guidance on how and when hand hygiene should be performed, including recommendations regarding surgical hand antisepsis and artificial nails can be found in the *Guideline for Hand Hygiene in Health-Care Settings* (available at: [http://www.cdc.gov/mmwr/PDF/rr/rr5116.pdf](http://www.cdc.gov/mmwr/PDF/rr/rr5116.pdf)).

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**Key Recommendations for HAND HYGIENE in Dental Settings**

1. Perform hand hygiene—
   a. When hands are visibly soiled.
   b. After barehanded touching of instruments, equipment, materials, and other objects likely to be contaminated by blood, saliva, or respiratory secretions.
   c. Before and after treating each patient.
   d. Before putting on gloves and again immediately after removing gloves.

2. Use soap and water when hands are visibly soiled (e.g., blood, body fluids); otherwise, an alcohol-based hand rub may be used.

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**Personal Protective Equipment**

Personal protective equipment (PPE) refers to wearable equipment that is designed to protect DHCP from exposure to or contact with infectious agents. PPE that is appropriate for various types of patient interactions and effectively covers personal clothing and skin likely to be soiled with blood, saliva, or other potentially infectious materials (OPIM) should be available. These include gloves, face masks, protective eye wear, face shields, and protective clothing (e.g., reusable or disposable gown, jacket, laboratory coat). Examples of appropriate use of PPE for adherence to Standard Precautions include—

- Use of gloves in situations involving possible contact with blood or body fluids, mucous membranes, non-intact skin (e.g., exposed skin that is chapped, abraded, or with dermatitis) or OPIM.
- Use of protective clothing to protect skin and clothing during procedures or activities where

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1 Definition from 2003 CDC Dental Guidelines — Oral surgical procedures involve the incision, excision, or reflection of tissue that exposes the normally sterile areas of the oral cavity. Examples include biopsy, periodontal surgery, apical surgery, implant surgery, and surgical extractions of teeth (e.g., removal of erupted or nonerupted tooth requiring elevation of mucoperiosteal flap, removal of bone or section of tooth, and suturing if needed).
contact with blood or body fluids is anticipated.

- Use of mouth, nose, and eye protection during procedures that are likely to generate splashes or sprays of blood or other body fluids.

DHCP should be trained to select and put on appropriate PPE and remove PPE so that the chance for skin or clothing contamination is reduced. Hand hygiene is always the final step after removing and disposing of PPE. Training should also stress preventing further spread of contamination while wearing PPE by:

- Keeping hands away from face.
- Limiting surfaces touched.
- Removing PPE when leaving work areas.
- Performing hand hygiene.


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**Key Recommendations for PERSONAL PROTECTIVE EQUIPMENT (PPE) in Dental Settings**

1. Provide sufficient and appropriate PPE and ensure it is accessible to DHCP.
2. Educate all DHCP on proper selection and use of PPE.
3. Wear gloves whenever there is potential for contact with blood, body fluids, mucous membranes, non-intact skin or contaminated equipment.
   a. Do not wear the same pair of gloves for the care of more than one patient.
   b. Do not wash gloves. Gloves cannot be reused.
4. Wear protective clothing that covers skin and personal clothing during procedures or activities where contact with blood, saliva, or OPIM is anticipated.
5. Wear mouth, nose, and eye protection during procedures that are likely to generate splashes or spattering of blood or other body fluids.
6. Remove PPE before leaving the work area.

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**Respiratory Hygiene/Cough Etiquette**

Respiratory hygiene/cough etiquette infection prevention measures are designed to limit the transmission of respiratory pathogens spread by droplet or airborne routes. The strategies target primarily patients and individuals accompanying patients to the dental setting who might have undiagnosed transmissible respiratory infections, but also apply to anyone (including DHCP) with signs of illness including cough, congestion, runny nose, or increased production of respiratory secretions.

DHCP should be educated on preventing the spread of respiratory pathogens when in contact with symptomatic persons. Respiratory hygiene/cough etiquette measures were added to Standard Precautions in 2007. Additional information related to respiratory hygiene/cough etiquette can be found in the 2007 Guideline for Isolation Precautions (available at: http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf). Recommendations for preventing the spread of influenza are available at: http://www.cdc.gov/flu/professionals/infectioncontrol/.
Key Recommendations for RESPIRATORY HYGIENE/COUGH ETIQUETTE in Dental Settings

1. Implement measures to contain respiratory secretions in patients and accompanying individuals who have signs and symptoms of a respiratory infection, beginning at point of entry to the facility and continuing throughout the visit.
   a. Post signs at entrances with instructions to patients with symptoms of respiratory infection to—
      i. Cover their mouths/noses when coughing or sneezing.
      ii. Use and dispose of tissues.
      iii. Perform hand hygiene after hands have been in contact with respiratory secretions.
   b. Provide tissues and no-touch receptacles for disposal of tissues.
   c. Provide resources for performing hand hygiene in or near waiting areas.
   d. Offer masks to coughing patients and other symptomatic persons when they enter the dental setting.
   e. Provide space and encourage persons with symptoms of respiratory infections to sit as far away from others as possible. If available, facilities may wish to place these patients in a separate area while waiting for care.

2. Educate DHCP on the importance of infection prevention measures to contain respiratory secretions to prevent the spread of respiratory pathogens when examining and caring for patients with signs and symptoms of a respiratory infection.

Sharps Safety

Most percutaneous injuries (e.g., needlestick, cut with a sharp object) among DHCP involve burs, needles, and other sharp instruments. Implementation of the OSHA Bloodborne Pathogens Standard has helped to protect DHCP from blood exposure and sharps injuries. However, sharps injuries continue to occur and pose the risk of bloodborne pathogen transmission to DHCP and patients. Most exposures in dentistry are preventable; therefore, each dental practice should have policies and procedures available addressing sharps safety. DHCP should be aware of the risk of injury whenever sharps are exposed. When using or working around sharp devices, DHCP should take precautions while using sharps, during cleanup, and during disposal.

Engineering and work-practice controls are the primary methods to reduce exposures to blood and OPIM from sharp instruments and needles. Whenever possible, engineering controls should be used as the primary method to reduce exposures to bloodborne pathogens. Engineering controls remove or isolate a hazard in the workplace and are frequently technology-based (e.g., self-sheathing anesthetic needles, safety scalpels, and needleless IV ports). Employers should involve those DHCP who are directly responsible for patient care (e.g., dentists, hygienists, dental assistants) in identifying, evaluating, and selecting devices with engineered safety features at least annually and as they become available. Other examples of engineering controls include sharps containers and needle recapping devices.

When engineering controls are not available or appropriate, work-practice controls should be used. Work-practice controls are behavior-based and are intended to reduce the risk of blood exposure by changing the way DHCP perform tasks, such as using...
a one-handed scoop technique for recapping needles between uses and before disposal. Other work-practice controls include not bending or breaking needles before disposal, not passing a syringe with an unsheathed needle by hand, removing burs before disassembling the handpiece from the dental unit, and using instruments in place of fingers for tissue retraction or palpation during suturing and administration of anesthesia.

All used disposable syringes and needles, scalpel blades, and other sharp items should be placed in appropriate puncture-resistant containers located close to the area where they are used. Sharps containers should be disposed of according to state and local regulated medical waste rules.

For more information about sharps safety, see the Guidelines for Infection Control in Dental Health-Care Settings—2003 (available at: www.cdc.gov/mmwr/PDF/rr/rr5217.pdf), the CDC Workbook for Designing, Implementing, and Evaluating a Sharps Injury Prevention Program (available at: www.cdc.gov/sharpsafety/), and the CDC Sample Screening and Device Evaluation Forms for Dentistry (available at: www.cdc.gov/oralhealth/infectioncontrol/forms.htm).

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Key Recommendations for SHARPS SAFETY in Dental Settings

1. Consider sharp items (e.g., needles, scalers, burs, lab knives, and wires) that are contaminated with patient blood and saliva as potentially infective and establish engineering controls and work practices to prevent injuries.

2. Do not recap used needles by using both hands or any other technique that involves directing the point of a needle toward any part of the body.

3. Use either a one-handed scoop technique or a mechanical device designed for holding the needle cap when recapping needles (e.g., between multiple injections and before removing from a non-disposable aspirating syringe).

4. Place used disposable syringes and needles, scalpel blades, and other sharp items in appropriate puncture-resistant containers located as close as possible to the area where the items are used.

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Safe Injection Practices

Safe injection practices are intended to prevent transmission of infectious diseases between one patient and another, or between a patient and DHCP during preparation and administration of parenteral (e.g., intravenous or intramuscular injection) medications. Safe injection practices are a set of measures DHCP should follow to perform injections in the safest possible manner for the protection of patients. DHCP most frequently handle parenteral medications when administering local anesthesia, during which needles and cartridges containing local anesthetics are used for one patient only and the dental cartridge syringe is cleaned and heat sterilized between patients. Other safe practices described here primarily apply to use of parenteral medications combined with fluid infusion systems, such as for patients undergoing conscious sedation. Unsafe practices that have led to patient harm include 1) use of a single syringe—with or without the same needle—to administer medication to multiple patients, 2) reinsertion of a used syringe—with or without the same needle—into a medication vial or solution container (e.g., saline bag) to obtain additional medication for a single patient and then
using that vial or solution container for subsequent patients, and 3) preparation of medications in close proximity to contaminated supplies or equipment.

Safe injection practices were covered in the Special Considerations section (Aseptic Technique for Parenteral Medications) of the 2003 CDC dental guidelines. However, because of reports of transmission of infectious diseases by inappropriate handling of injectable medications, CDC now considers safe injection practices to be a formal element of Standard Precautions. Complete guidance on safe injection practices can be found in the 2007 Guideline for Isolation Precautions (available at: http://www.cdc.gov/hicpac/pdf/isolation/isolation2007.pdf).

Additional materials, including a list of frequently asked questions from providers and a patient notification toolkit, are also available (http://www.cdc.gov/injectionsafety/). The One & Only Campaign is a public health effort to eliminate unsafe medical injections. The campaign is led by CDC and the Safe Injection Practices Coalition (SIPC). To learn more about safe injection practices and access training videos and resources, please visit http://www.oneandonlycampaign.org/.

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**Key Recommendations for SAFE INJECTION PRACTICES in Dental Settings**

1. Prepare injections using aseptic technique\(^2\) in a clean area.
2. Disinfect the rubber septum on a medication vial with alcohol before piercing.
3. Do not use needles or syringes* for more than one patient (this includes manufactured prefilled syringes and other devices such as insulin pens).
4. Medication containers (single and multidose vials, ampules, and bags) are entered with a new needle and new syringe, even when obtaining additional doses for the same patient.
5. Use single-dose vials for parenteral medications when possible.
6. Do not use single-dose (single-use) medication vials, ampules, and bags or bottles of intravenous solution for more than one patient.
7. Do not combine the leftover contents of single-use vials for later use.

8. The following apply if multidose vials are used—
   a. Dedicate multidose vials to a single patient whenever possible.
   b. If multidose vials will be used for more than one patient, they should be restricted to a centralized medication area and should not enter the immediate patient treatment area (e.g., dental operatory) to prevent inadvertent contamination.
   c. If a multidose vial enters the immediate patient treatment area, it should be dedicated for single-patient use and discarded immediately after use.
   d. Date multidose vials when first opened and discard within 28 days, unless the manufacturer specifies a shorter or longer date for that opened vial.

9. Do not use fluid infusion or administration sets (e.g., IV bags, tubings, connections) for more than one patient.

---

\(^2\) A technique that prevents or reduces the spread of microorganisms from one site to another, such as from patient to DHCP, from patient to operatory surfaces, or from one operatory surface to another.

* A Note about Administering Local Dental Anesthesia: When using a dental cartridge syringe to administer local anesthesia, do not use the needle or anesthetic cartridge for more than one patient. Ensure that the dental cartridge syringe is appropriately cleaned and heat sterilized before use on another patient.
Sterilization and Disinfection of Patient-Care Items and Devices

Instrument processing requires multiple steps using specialized equipment. Each dental practice should have policies and procedures in place for containing, transporting, and handling instruments and equipment that may be contaminated with blood or body fluids. Manufacturer’s instructions for reprocessing reusable dental instruments and equipment should be readily available—ideally in or near the reprocessing area. Most single-use devices are labeled by the manufacturer for only a single use and do not have reprocessing instructions. Use single-use devices for one patient only and dispose of appropriately.

Cleaning, disinfection and sterilization of dental equipment should be assigned to DHCP with training in the required reprocessing steps to ensure reprocessing results in a device that can be safely used for patient care. Training should also include the appropriate use of PPE necessary for safe handling of contaminated equipment.

Patient-care items (e.g., dental instruments, devices, and equipment) are categorized as critical, semicritical, or noncritical, depending on the potential risk for infection associated with their intended use.

- Critical items, such as surgical instruments and periodontal scalers, are those used to penetrate soft tissue or bone. They have the greatest risk of transmitting infection and should always be sterilized using heat.
- Semicritical items (e.g., mouth mirrors, amalgam condensers, reusable dental impression trays) are those that come in contact with mucous membranes or non-intact skin (e.g., exposed skin that is chapped, abraded, or has dermatitis). These items have a lower risk of transmission. Because the majority of semicritical items in dentistry are heat-tolerant, they should also be sterilized using heat. If a semicritical item is heat-sensitive, DHCP should replace it with a heat-tolerant or disposable alternative. If none are available, it should, at a minimum, be processed using high-level disinfection.

**Note:** Dental handpieces and associated attachments, including low-speed motors and reusable prophylaxis angles, should always be heat sterilized between patients and not high-level or surface disinfected. Although these devices are considered semicritical, studies have shown that their internal surfaces can become contaminated with patient materials during use. If these devices are not properly cleaned and heat sterilized, the next patient may be exposed to potentially infectious materials.

Digital radiography sensors are also considered semicritical and should be protected with a Food and Drug Administration (FDA)-cleared barrier to reduce contamination during use, followed by cleaning and heat sterilization or high-level disinfection between patients. If the item cannot tolerate these procedures then, at a minimum, protect with an FDA-cleared barrier. In addition, clean and disinfect with an Environmental Protection Agency (EPA)-registered hospital disinfectant with intermediate-level (i.e., tuberculocidal claim) activity between patients. Because these items vary by manufacturer and their ability to be sterilized or high-level disinfected also vary, refer to manufacturer instructions for reprocessing.

- Noncritical patient-care items (e.g., radiograph head/cone, blood pressure cuff, facebow) are those that only contact intact skin. These items pose the least risk of transmission of infection. In the majority of cases, cleaning, or if visibly soiled, cleaning followed by disinfection with an EPA-registered hospital disinfectant is adequate. Protecting these surfaces with disposable barriers might be a preferred alternative.

Cleaning to remove debris and organic contamination from instruments should always occur before disinfection or sterilization. If blood, saliva, and other contamination are not removed, these materials can shield microorganisms and potentially compromise
the disinfection or sterilization process. Automated cleaning equipment (e.g., ultrasonic cleaner, washer-disinfector) should be used to remove debris to improve cleaning effectiveness and decrease worker exposure to blood. After cleaning, dried instruments should be inspected, wrapped, packaged, or placed into container systems before heat sterilization. Packages should be labeled to show the sterilizer used, the cycle or load number, the date of sterilization, and, if applicable, the expiration date. This information can help in retrieving processed items in the event of an instrument processing/sterilization failure.

The ability of a sterilizer to reach conditions necessary to achieve sterilization should be monitored using a combination of biological, mechanical, and chemical indicators. Biological indicators, or spore tests, are the most accepted method for monitoring the sterilization process because they assess the sterilization process directly by killing known highly resistant microorganisms (e.g., *Geobacillus* or *Bacillus* species). A spore test should be used at least weekly to monitor sterilizers. However, because spore tests are only performed periodically (e.g., once a week, once a day) and the results are usually not obtained immediately, mechanical and chemical monitoring should also be performed.

Mechanical and chemical indicators do not guarantee sterilization; however, they help detect procedural errors and equipment malfunctions. Mechanical monitoring involves checking the sterilizer gauges, computer displays, or printouts; and documenting the sterilization pressure, temperature, and exposure time in your sterilization records. Since these parameters can be observed during the sterilization cycle, this might be the first indication of a problem.

Chemical monitoring uses sensitive chemicals that change color when exposed to high temperatures or combinations of time and temperature. Examples include chemical indicator tapes, strips or tabs, and special markings on packaging materials. Chemical monitoring results are obtained immediately following the sterilization cycle and therefore can provide more timely information about the sterilization cycle than a spore test. A chemical indicator should be used inside every package to verify that the sterilizing agent (e.g., steam) has penetrated the package and reached the instruments inside. If the internal chemical indicator is not visible from the outside of the package, an external indicator should also be used. External indicators can be inspected immediately when removing packages from the sterilizer. If the appropriate color change did not occur, do not use the instruments. Chemical indicators also help to differentiate between processed and unprocessed items, eliminating the possibility of using instruments that have not been sterilized.

**Note:** A single-parameter internal chemical indicator provides information regarding only one sterilization parameter (e.g., time or temperature). Multiparameter internal chemical indicators are designed to react to ≥ 2 parameters (e.g., time and temperature; or time, temperature, and the presence of steam) and can provide a more reliable indication that sterilization conditions have been met.

Sterilization monitoring (e.g., biological, mechanical, chemical monitoring) and equipment maintenance records are an important component of a dental infection prevention program. Maintaining accurate records ensures cycle parameters have been met and establishes accountability. In addition, if there is a problem with a sterilizer (e.g., unchanged chemical indicator, positive spore test), documentation helps to determine if an instrument recall is necessary.

Ideally, sterile instruments and supplies should be stored in covered or closed cabinets. Wrapped packages of sterilized instruments should be inspected before opening and use to ensure the packaging material has not been compromised (e.g., wet, torn, punctured) during storage. The contents of any compromised packs should be reprocessed (i.e., cleaned, packaged, and heat-sterilized again) before use on a patient.

Recommendations for the cleaning, disinfection, and sterilization of dental equipment can be found in the *Guidelines for Infection Control in Dental*
Key Recommendations for STERILIZATION AND DISINFECTION OF PATIENT-CARE DEVICES for Dental Settings

1. Clean and reprocess (disinfect or sterilize) reusable dental equipment appropriately before use on another patient.
2. Clean and reprocess reusable dental equipment according to manufacturer instructions. If the manufacturer does not provide such instructions, the device may not be suitable for multi-patient use.
   a. Have manufacturer instructions for reprocessing reusable dental instruments/equipment readily available, ideally in or near the reprocessing area.
3. Assign responsibilities for reprocessing of dental equipment to DHCP with appropriate training.
4. Wear appropriate PPE when handling and reprocessing contaminated patient equipment.
5. Use mechanical, chemical, and biological monitors according to manufacturer instructions to ensure the effectiveness of the sterilization process. Maintain sterilization records in accordance with state and local regulations.

Environmental Infection Prevention and Control

Policies and procedures for routine cleaning and disinfection of environmental surfaces should be included as part of the infection prevention plan. Cleaning removes large numbers of microorganisms from surfaces and should always precede disinfection. Disinfection is generally a less lethal process of microbial inactivation (compared with sterilization) that eliminates virtually all recognized pathogenic microorganisms but not necessarily all microbial forms (e.g., bacterial spores).

Emphasis for cleaning and disinfection should be placed on surfaces that are most likely to become contaminated with pathogens, including clinical contact surfaces (e.g., frequently touched surfaces such as light handles, bracket trays, switches on dental units, computer equipment) in the patient-care area. When these surfaces are touched, microorganisms can be transferred to other surfaces, instruments or to the nose, mouth, or eyes of DHCP or patients. Although hand hygiene is the key to minimizing the spread of microorganisms, clinical contact surfaces should be barrier protected or cleaned and disinfected between patients. EPA-registered hospital disinfectants or detergents/disinfectants with label claims for use in health care settings should be used for disinfection. Disinfectant products should not be used as cleaners unless the label indicates the product is suitable for such use. DHCP should follow manufacturer recommendations for use of products selected for cleaning and disinfection (e.g., amount, dilution, contact time, safe use, and disposal). Facility policies and procedures should also address prompt and appropriate cleaning and decontamination of spills of blood or other potentially infectious materials. Housekeeping surfaces, (e.g., floors, walls, sinks) carry less risk of disease transmission than clinical contact.
surfaces and can be cleaned with soap and water or cleaned and disinfected if visibly contaminated with blood.


Key Recommendations for ENVIRONMENTAL INFECTION PREVENTION AND CONTROL in Dental Settings

1. Establish policies and procedures for routine cleaning and disinfection of environmental surfaces in dental health care settings.
   a. Use surface barriers to protect clinical contact surfaces, particularly those that are difficult to clean (e.g., switches on dental chairs, computer equipment) and change surface barriers between patients.
   b. Clean and disinfect clinical contact surfaces that are not barrier-protected with an EPA-registered hospital disinfectant after each patient. Use an intermediate-level disinfectant (i.e., tuberculocidal claim) if visibly contaminated with blood.

2. Select EPA-registered disinfectants or detergents/disinfectants with label claims for use in health care settings.

3. Follow manufacturer instructions for use of cleaners and EPA-registered disinfectants (e.g., amount, dilution, contact time, safe use, disposal).

Dental Unit Water Quality

Dental unit waterlines (i.e., plastic tubing that carries water to the high-speed handpiece, air/water syringe, and ultrasonic scaler) promote bacterial growth and development of biofilm due to the presence of long narrow-bore tubing, inconsistent flow rates, and the potential for retraction of oral fluids. Dental health care personnel and patients could be placed at risk of adverse health effects if water is not appropriately treated.

All dental units should use systems that treat water to meet drinking water standards (i.e., ≤ 500 CFU/mL of heterotrophic water bacteria). Independent reservoirs—or water-bottle systems—alone are not sufficient. Commercial products and devices are available that can improve the quality of water used in dental treatment. Consult with the dental unit manufacturer for appropriate water maintenance methods and recommendations for monitoring dental water quality. During surgical procedures, use only sterile solutions as a coolant/irrigant using an appropriate delivery device, such as a sterile bulb syringe, sterile tubing that bypasses dental unit waterlines, or sterile single-use devices.

Guidance on dental unit water quality can be found in the Guidelines for Infection Control in Dental Health-Care Settings—2003 (available at: www.cdc.gov/mmwr/PDF/rr/rr5217.pdf), and the CDC Boil-Water Advisories and the Dental Office Fact Sheet (available at: http://www.cdc.gov/oralhealth/infectioncontrol/faq/dentalunitwaterquality.htm).
Key Recommendations for DENTAL UNIT WATER QUALITY in Dental Settings

1. Use water that meets EPA regulatory standards for drinking water (i.e., ≤ 500 CFU/mL of heterotrophic water bacteria) for routine dental treatment output water.

2. Consult with the dental unit manufacturer for appropriate methods and equipment to maintain the quality of dental water.

3. Follow recommendations for monitoring water quality provided by the manufacturer of the unit or waterline treatment product.

4. Use sterile saline or sterile water as a coolant/irrigant when performing surgical procedures.

Risk Assessment

Facilities are encouraged to use the Infection Prevention Checklist for Dental Settings (Appendix A)—a companion to the summary guide—to periodically assess practices in their facility and ensure they are meeting the minimum expectations for safe care. In the course of auditing practices, facilities may identify lapses in infection control. If such lapses are identified, efforts should be made to correct the practices, appropriately educate DHCP (if applicable), and determine why the correct practice was not being performed. In addition, consideration should also be made for determining the risk posed to patients by the deficient practices. Certain infection control lapses (e.g., reuse of syringes on more than one patient or to access a medication container that is used for subsequent patients, reuse of lancets) have resulted in bloodborne pathogen transmission and should be halted immediately. Identification of such lapses warrants immediate consultation with the state or local health department and appropriate notification and testing of potentially affected patients. Additional resources describing approaches to evaluation and management of infection control breaches identified in health care settings—including those involving lapses related to reprocessing of medical devices—can be found in CDC’s Steps for Evaluating an Infection Control Breach (available at: http://www.cdc.gov/hai/outbreaks/steps_for_eval_IC_breach.html). In addition, for circumstances warranting patient notification, CDC has developed a Patient Notification Toolkit (available at: http://www.cdc.gov/injectionsafety/pntoolkit/index.html) to assist health care facilities with conducting a patient notification.

Conclusions

The information presented in this document represents basic infection prevention expectations for safe care in dental health care settings. This guidance is not all-encompassing. DHCP and others are encouraged to refer to the original source documents, which provide more detailed guidance and references for the information included in this guide. DHCP are also encouraged to visit the main CDC Web page (www.cdc.gov) for the most current infection prevention information about emerging pathogens and updated information about existing recommendations.
Source Documents

Dental Infection Prevention Guidelines
Guidelines for Infection Control in Dental Health-Care Settings—2003
www.cdc.gov/mmwr/PDF/rr/rr5217.pdf

General Infection Prevention Guidelines
2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings


Guideline for Hand Hygiene in Health-Care Settings, 2002
www.cdc.gov/mmwr/PDF/rr/rr5116.pdf

Guideline for Infection Control in Healthcare Personnel, 1998
www.cdc.gov/hicpac/pdf/InfectControl98.pdf

Guidelines for Environmental Infection Control in Health-Care Facilities, 2003
www.cdc.gov/hicpac/pdf/guidelines/eic_in_HCF_03.pdf

Guidelines for Preventing the Transmission of Mycobacterium Tuberculosis in Health-Care Settings, 2005
www.cdc.gov/mmwr/pdf/rr/rr5417.pdf

Immunization of Health-Care Personnel: Recommendations of the Advisory Committee on Immunization, 2011
www.cdc.gov/mmwr/pdf/rr/rr6007.pdf

Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006

Key Links for Additional Information
CDC Division of Oral Health
www.cdc.gov/oralhealth

CDC/Healthcare Infection Control Practices Advisory Committee (HICPAC) Guidelines for Prevention of Healthcare Associated Infections
www.cdc.gov/hicpac/pubs.html

CDC Web site on Hand Hygiene
www.cdc.gov/handwashing

CDC Web site on Influenza
www.cdc.gov/flu

CDC Web site on Injection Safety
www.cdc.gov/injectionsafety
Appendix A

Infection Prevention Checklist for Dental Settings: Basic Expectations for Safe Care

The following is a companion to the Summary of Infection Prevention Practices in Dental Settings: Basic Expectations for Safe Care. The checklist should be used—

1. To ensure the dental health care setting has appropriate infection prevention policies and practices in place, including appropriate training and education of dental health care personnel (DHCP) on infection prevention practices, and adequate supplies to allow DHCP to provide safe care and a safe working environment.

2. To systematically assess personnel compliance with the expected infection prevention practices and to provide feedback to DHCP regarding performance. Assessment of compliance should be conducted by direct observation of DHCP during the performance of their duties.

DHCP using this checklist should identify all procedures performed in their setting and refer to appropriate sections of this checklist to conduct their evaluation. Certain sections may not apply (e.g., some settings may not perform surgical procedures or use medications in vials, such as for conscious sedation). If the answer to any of the applicable listed questions is no, efforts should be made to determine why the correct practice was not being performed, correct the practice, educate DHCP (if applicable), and reassess the practice to ensure compliance. Consideration should also be made to determine the risk posed to patients by the deficient practice. Certain infection prevention and control lapses (e.g., re-use of syringes on more than one patient, sterilization failures) can result in bloodborne pathogen transmission and measures to address the lapses should be taken immediately. Identification of such lapses may warrant immediate consultation with the state or local health department and appropriate notification and testing of potentially affected patients.

Section I lists administrative policies and dental setting practices that should be included in the site-specific written infection prevention and control program with supportive documentation. Section II describes personnel compliance with infection prevention and control practices that fulfill the expectations for dental health care settings. This checklist can serve as an evaluation tool to monitor DHCP compliance with the CDC’s recommendations and provide an assurance of quality control.
## Infection Prevention Checklist

### Section I: Policies and Practices

#### I.1 Administrative Measures

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A.</strong> Written infection prevention policies and procedures specific for the dental setting are available, current, and based on evidence-based guidelines (e.g., CDC/Healthcare Infection Control Practices Advisory Committee [HICPAC]), regulations, or standards</td>
<td>Yes ☑ No</td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> Policies and procedures should be appropriate for the services provided by the dental setting and should extend beyond the Occupational Safety and Health Administration (OSHA) bloodborne pathogens training.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B.</strong> Infection prevention policies and procedures are reassessed at least annually or according to state or federal requirements, and updated if appropriate</td>
<td>Yes ☑ No</td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> This may be performed during the required annual review of the dental setting's OSHA Exposure Control Plan.</td>
<td></td>
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<tr>
<td><strong>C.</strong> At least one individual trained in infection prevention is assigned responsibility for coordinating the program</td>
<td>Yes ☑ No</td>
<td></td>
</tr>
<tr>
<td><strong>D.</strong> Supplies necessary for adherence to Standard Precautions are readily available</td>
<td>Yes ☑ No</td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> This includes, but is not limited to hand hygiene products, safer devices to reduce percutaneous injuries, and personal protective equipment (PPE).</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E.</strong> Facility has system for early detection and management of potentially infectious persons at initial points of patient encounter</td>
<td>Yes ☑ No</td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> System may include taking a travel and occupational history, as appropriate, and elements described under respiratory hygiene/cough etiquette.</td>
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Facility name: ..................................................
Completed by: ..............................................
Date: ..........................................................
### I.2 Infection Prevention Education and Training

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
</tr>
</thead>
</table>
| **A.** DHCP receive job or task-specific training on infection prevention policies and procedures and the OSHA bloodborne pathogens standard —  
  a. upon hire  
  b. annually  
  c. when new tasks or procedures affect the employee's occupational exposure  
  d. according to state or federal requirements | ❑ Yes ❑ No | ❑ Yes ❑ No                   |
| **Note:** This includes those employed by outside agencies and available by contract or on a volunteer basis to the dental setting. |            |                            |

**B.** Training records are maintained in accordance with state and federal requirements | ❑ Yes ❑ No |

### I.3 Dental Health Care Personnel Safety

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
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</thead>
<tbody>
<tr>
<td><strong>A.</strong> Facility has an exposure control plan that is tailored to the specific requirements of the facility (e.g., addresses potential hazards posed by specific services provided by the facility)</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> A model template that includes a guide for creating an exposure control plan that meets the requirements of the OSHA Bloodborne Pathogens Standard is available at: <a href="https://www.osha.gov/Publications/osha3186.pdf">https://www.osha.gov/Publications/osha3186.pdf</a>.</td>
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</table>

**B.** DHCP for whom contact with blood or OPIM is anticipated are trained on the OSHA Bloodborne Pathogens Standard:  
  a. upon hire  
  b. at least annually | ❑ Yes ❑ No |

**C.** Current CDC recommendations for immunizations, evaluation, and follow-up are available. There is a written policy regarding immunizing DHCP, including a list of all required and recommended immunizations for DHCP (e.g., hepatitis B, MMR (measles, mumps, rubella), varicella (chickenpox), Tdap (tetanus, diphtheria, pertussis) | ❑ Yes ❑ No |
### I.3 Dental Health Care Personnel Safety

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
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</thead>
<tbody>
<tr>
<td><strong>D.</strong> Hepatitis B vaccination is available at no cost to all employees who are at risk of occupational exposure to blood or other potentially infectious material (OPIM)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>E.</strong> Post-vaccination screening for protective levels of hepatitis B surface antibody is conducted 1-2 months after completion of the 3-dose vaccination series</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>F.</strong> All DHCP are offered annual influenza vaccination</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Note:</strong> Providing the vaccination at no cost is a strategy that may increase use of this preventive service.</td>
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<tr>
<td><strong>G.</strong> All DHCP receive baseline tuberculosis (TB) screening upon hire regardless of the risk classification of the setting</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>H.</strong> A log of needlesticks, sharps injuries, and other employee exposure events is maintained according to state or federal requirements</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>I.</strong> Referral arrangements are in place to qualified health care professionals (e.g., occupational health program of a hospital, educational institutions, health care facilities that offer personnel health services) to ensure prompt and appropriate provision of preventive services, occupationally-related medical services, and postexposure management with medical follow-up</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>J.</strong> Following an occupational exposure event, postexposure evaluation and follow-up, including prophylaxis as appropriate, are available at no cost to employee and are supervised by a qualified health care professional</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
| **K.** Facility has well-defined policies concerning contact of personnel with patients when personnel have potentially transmissible conditions. These policies include—  
  a. work-exclusion policies that encourage reporting of illnesses and do not penalize staff with loss of wages, benefits, or job status  
  b. education of personnel on the importance of prompt reporting of illness to supervisor | Yes        | No                          |
### I.4 Program Evaluation

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
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</thead>
<tbody>
<tr>
<td><strong>A.</strong> Written policies and procedures for routine monitoring and evaluation of the infection prevention and control program are available</td>
<td>☐ Yes ☐ No</td>
<td></td>
</tr>
<tr>
<td><strong>B.</strong> Adherence with certain practices such as immunizations, hand hygiene, sterilization monitoring, and proper use of PPE is monitored and feedback is provided to DHCP</td>
<td>☐ Yes ☐ No</td>
<td></td>
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### I.5 Hand Hygiene

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
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<th>Notes/Areas For Improvement</th>
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</thead>
<tbody>
<tr>
<td><strong>A.</strong> Supplies necessary for adherence to hand hygiene for routine dental procedures (e.g., soap, water, paper towels, alcohol-based hand rub) are readily accessible to DHCP</td>
<td>☐ Yes ☐ No</td>
<td></td>
</tr>
<tr>
<td>a. if surgical procedures are performed, appropriate supplies are available for surgical hand scrub technique (e.g., antimicrobial soap, alcohol-based hand scrub with persistent activity)</td>
<td>☐ Yes ☐ No</td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> Examples of surgical procedures include biopsy, periodontal surgery, apical surgery, implant surgery, and surgical extractions of teeth.</td>
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<tr>
<td><strong>B.</strong> DHCP are trained regarding appropriate indications for hand hygiene including handwashing, hand antisepsis, and surgical hand antisepsis</td>
<td>☐ Yes ☐ No</td>
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<tr>
<td><strong>Note:</strong> Use soap and water when hands are visibly soiled (e.g., blood, body fluids). Alcohol-based hand rub may be used in all other situations.</td>
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### I.6 Personal Protective Equipment (PPE)

<table>
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<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
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<tbody>
<tr>
<td><strong>A.</strong> Sufficient and appropriate PPE is available (e.g., examination gloves, surgical face masks, protective clothing, protective eyewear/face shields, utility gloves, sterile surgeon’s gloves for surgical procedures) and readily accessible to DHCP</td>
<td>☐ Yes ☐ No</td>
<td></td>
</tr>
<tr>
<td><strong>B.</strong> DHCP receive training on proper selection and use of PPE</td>
<td>☐ Yes ☐ No</td>
<td></td>
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</tbody>
</table>
### I.7 Respiratory Hygiene/Cough Etiquette

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
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<tbody>
<tr>
<td><strong>A.</strong> Policies and procedures to contain respiratory secretions in people who have</td>
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<tr>
<td>signs and symptoms of a respiratory infection, beginning at point of entry to the dental</td>
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<tr>
<td>setting have been implemented. Measures include—</td>
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<tr>
<td>a. posting signs at entrances (with instructions to patients with symptoms of</td>
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<tr>
<td>respiratory infection to cover their mouths/noses when coughing or sneezing, use and</td>
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<tr>
<td>dispose of tissues, and perform hand hygiene after hands have been in contact with</td>
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<td></td>
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<tr>
<td>respiratory secretions)</td>
<td>Yes ❑ No</td>
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<tr>
<td>b. providing tissues and no-touch receptacles for disposal of tissues</td>
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</tr>
<tr>
<td>c. providing resources for patients to perform hand hygiene in or near waiting areas</td>
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<tr>
<td>d. offering face masks to coughing patients and other symptomatic persons when they</td>
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<tr>
<td>enter the setting</td>
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<tr>
<td>e. providing space and encouraging persons with respiratory symptoms to sit as far</td>
<td>Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>away from others as possible—if possible, a separate waiting area is ideal</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B.</strong> DHCP receive training on the importance of containing respiratory secretions</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>in people who have signs and symptoms of a respiratory infection</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### I.8 Sharps Safety

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A.</strong> Written policies, procedures, and guidelines for exposure prevention and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>postexposure management are available</td>
<td>Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td><strong>B.</strong> DHCP identify, evaluate, and select devices with engineered safety features</td>
<td></td>
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<tr>
<td>(e.g., safer anesthetic syringes, blunt suture needle, safety scalpels, or needleless</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV systems)—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. at least annually</td>
<td>Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>b. as they become available in the market</td>
<td>Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> If staff inquire about the availability of new safety devices or safer</td>
<td></td>
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<tr>
<td>options and find none are available, DHCP can document these findings in their office</td>
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<tr>
<td>exposure control plan.</td>
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</tbody>
</table>
## I.9 Safe Injection Practices

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Written policies, procedures, and guidelines for safe injection practices (e.g., aseptic technique for parenteral medications) are available</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>B. Injections are required to be prepared using aseptic technique in a clean area free from contamination or contact with blood, body fluids, or contaminated equipment</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
</tbody>
</table>

## I.10 Sterilization and Disinfection of Patient-Care Items and Devices

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Written policies and procedures are available to ensure reusable patient care instruments and devices are cleaned and reprocessed appropriately before use on another patient</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>B. Policies, procedures, and manufacturer reprocessing instructions for reusable instruments and dental devices are available, ideally in or near the reprocessing areas</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
</tbody>
</table>
| C. DHCP responsible for reprocessing reusable dental instruments and devices are appropriately trained —  
  a. upon hire                                                                 | ❑ Yes ❑ No |                             |
  b. at least annually                                                             | ❑ Yes ❑ No |                             |
  c. whenever new equipment or processes are introduced                             | ❑ Yes ❑ No |                             |
| D. Training and equipment are available to ensure that DHCP wear appropriate PPE (e.g., examination or heavy duty utility gloves, protective clothing, masks, eye protection) to prevent exposure to infectious agents or chemicals | ❑ Yes ❑ No |                             |
| Note: The exact type of PPE depends on infectious or chemical agent and anticipated type of exposure. |            |                             |
| E. Routine maintenance for sterilization equipment is —  
  a. performed according to manufacturer instructions                                | ❑ Yes ❑ No |                             |
  b. documented by written maintenance records                                       | ❑ Yes ❑ No |                             |
### I.10 Sterilization and Disinfection of Patient-Care Items and Devices

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<tr>
<th>Elements To Be Assessed</th>
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<th>Notes/Areas For Improvement</th>
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<tbody>
<tr>
<td>F. Policies and procedures are in place outlining dental setting response (e.g., recall of device, risk assessment) in the event of a reprocessing error/failure</td>
<td>Yes/No</td>
<td></td>
</tr>
</tbody>
</table>

### I.11 Environmental Infection Prevention and Control

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Written policies and procedures are available for routine cleaning and disinfection of environmental surfaces (i.e., clinical contact and housekeeping)</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>B. DHCP performing environmental infection prevention procedures receive job-specific training about infection prevention and control management of clinical contact and housekeeping surfaces—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. upon hire</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>b. when procedures/policies change</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>c. at least annually</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>C. Training and equipment are available to ensure that DHCP wear appropriate PPE (e.g., examination or heavy duty utility gloves, protective clothing, masks, and eye protection) to prevent exposure to infectious agents or chemicals</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>D. Cleaning, disinfection, and use of surface barriers are periodically monitored and evaluated to ensure that they are consistently and correctly performed</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>E. Procedures are in place for decontamination of spills of blood or other body fluids</td>
<td>Yes/No</td>
<td></td>
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</tbody>
</table>
## I.12 Dental Unit Water Quality

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
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<th>Notes/Areas For Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A.</strong> Policies and procedures are in place for maintaining dental unit water quality that meets Environmental Protection Agency (EPA) regulatory standards for drinking water (i.e., ≤ 500 CFU/mL of heterotrophic water bacteria) for routine dental treatment output water</td>
<td>☐ Yes ☐ No</td>
<td></td>
</tr>
<tr>
<td><strong>B.</strong> Policies and procedures are in place for using sterile water as a coolant/irrigant when performing surgical procedures</td>
<td>☐ Yes ☐ No</td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> Examples of surgical procedures include biopsy, periodontal surgery, apical surgery, implant surgery, and surgical extractions of teeth.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C.</strong> Written policies and procedures are available outlining response to a community boil-water advisory</td>
<td>☐ Yes ☐ No</td>
<td></td>
</tr>
</tbody>
</table>
## Infection Prevention Checklist

### Section II: Direct Observation of Personnel and Patient-Care Practices

#### II.1 Hand Hygiene is Performed Correctly

<table>
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<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. When hands are visibly soiled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. After barehanded touching of instruments, equipment, materials and other objects likely to be contaminated by blood, saliva, or respiratory secretions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Before and after treating each patient</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Before putting on gloves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Immediately after removing gloves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. Surgical hand scrub is performed before putting on sterile surgeon's gloves for all surgical procedures</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Examples of surgical procedures include biopsy, periodontal surgery, apical surgery, implant surgery, and surgical extractions of teeth.

#### II.2 Personal Protective Equipment (PPE) is Used Correctly

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. PPE is removed before leaving the work area (e.g., dental patient care, instrument processing, or laboratory areas)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Hand hygiene is performed immediately after removal of PPE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Masks, Protective Eyewear, and Face Shields</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. DHCP wear surgical masks during procedures that are likely to generate splashes or sprays of blood or other body fluids</td>
<td>Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>b. DHCP wear eye protection with solid side shields or a face shield during procedures that are likely to generate splashes or sprays of blood or other body fluids</td>
<td>Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>c. DHCP change masks between patients and during patient treatment if the mask becomes wet</td>
<td>Yes ❑ No</td>
<td></td>
</tr>
</tbody>
</table>
II.2 Personal Protective Equipment (PPE) is Used Correctly

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</thead>
<tbody>
<tr>
<td><strong>D. Gloves</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. DHCP wear gloves for potential contact with blood, body fluids, mucous membranes, non-intact skin, or contaminated equipment</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>b. DHCP change gloves between patients; do not wear the same pair of gloves for the care of more than one patient</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>c. DHCP do not wash examination or sterile surgeon’s gloves for the purpose of reuse</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>d. DHCP wear puncture- and chemical-resistant utility gloves when cleaning instruments and performing housekeeping tasks involving contact with blood or OPIM</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>e. DHCP wear sterile surgeon’s gloves for all surgical procedures</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Note:</strong> Examples of surgical procedures include biopsy, periodontal surgery, apical surgery, implant surgery, and surgical extractions of teeth.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. DHCP remove gloves that are torn, cut, or punctured and perform hand hygiene before putting on new gloves</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>E. Protective Clothing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. DHCP wear protective clothing (e.g., reusable or disposable gown, laboratory coat, or uniform) that covers personal clothing and skin (e.g., forearms) likely to be soiled with blood, saliva, or OPIM</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>b. DHCP change protective clothing if visibly soiled and immediately or as soon as possible if penetrated by blood or other potentially infectious fluids</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

II.3 Respiratory Hygiene/Cough Etiquette

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A.</strong> Signs are posted at entrances (with instructions to patients with symptoms of respiratory infection to cover their mouths/noses when coughing or sneezing, use and dispose of tissues, and perform hand hygiene after hands have been in contact with respiratory secretions)</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
### II.3 Respiratory Hygiene/Cough Etiquette

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Tissues and no-touch receptacles for disposal of tissues are provided</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>C. Resources are provided for patients to perform hand hygiene in or near waiting areas</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>D. Face masks are offered to coughing patients and other symptomatic persons when they enter the setting</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>E. Persons with respiratory symptoms are encouraged to sit as far away from others as possible. If possible, a separate waiting area is ideal</td>
<td>Yes/No</td>
<td></td>
</tr>
</tbody>
</table>

### II.4 Sharps Safety

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Engineering controls (e.g., self-sheathing anesthetic needles, safety scalpels, needleless IV ports) are used to prevent injuries</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>B. Work practice controls (e.g., one-handed scoop technique for recapping needles, removing burs before disconnecting handpieces) are used to prevent injuries</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>C. DHCP do not recap used needles by using both hands or any other technique that involves directing the point of a needle toward any part of the body</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>D. DHCP use either a one-handed scoop technique or a mechanical device designed for holding the needle cap when recapping needles (e.g., between multiple injections and before removing from a reusable aspirating syringe)</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>E. All sharps are disposed of in a puncture-resistant sharps container located as close as possible to the area in which the items are used</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>F. Sharps containers are disposed of in accordance with federal, state and local regulated medical waste rules and regulations</td>
<td>Yes/No</td>
<td></td>
</tr>
</tbody>
</table>
## II.5 Safe Injection Practices

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Injections are prepared using an aseptic technique in a clean area free from contaminants or contact with blood, body fluids, or contaminated equipment</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>B. Needles and syringes are used for only one patient (this includes manufactured prefilled syringes and other devices such as insulin pens)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Note:</strong> When using a dental cartridge syringe to administer local anesthesia, do not use the needle, syringe, or anesthetic cartridge for more than one patient. Ensure that the dental cartridge syringe is appropriately cleaned and heat sterilized before use on another patient.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. The rubber septum on a medication vial is disinfected with alcohol before piercing</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>D. Medication containers (single and multidose vials, ampules, and bags) are entered with a new needle and a new syringe, even when obtaining additional doses for the same patient</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>E. Single-dose (single-use) vials, ampules, and bags or bottles of intravenous solutions are used for only one patient</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>F. Leftover contents of single-dose vials, ampules, and bags of intravenous solutions are not combined for later use</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G. Single-dose vials for parenteral medications are used when possible</td>
<td>Yes</td>
<td>No</td>
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## II.5 Safe Injection Practices

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<tr>
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</thead>
<tbody>
<tr>
<td><strong>H.</strong> When using multidose medication vials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. multidose vials are dedicated to individual patients whenever possible</td>
<td>☑ Yes ☐ No</td>
<td></td>
</tr>
<tr>
<td>b. multidose vials to be used for more than one patient are kept in a centralized medication area and do not enter the immediate patient treatment area (e.g., dental operatory) to prevent inadvertent contamination of the vial</td>
<td>☑ Yes ☐ No</td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> If a multidose vial enters the immediate patient treatment area it should be dedicated for single-patient use and discarded immediately after use.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. multidose vials are dated when first opened and discarded within 28 days unless the manufacturer specifies a shorter or longer date for that opened vial</td>
<td>☑ Yes ☐ No</td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> This is different from the expiration date printed on the vial.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>I.</strong> Fluid infusion and administration sets (i.e., IV bags, tubings, and connections) are used for one patient only and disposed of appropriately</td>
<td>☑ Yes ☐ No</td>
<td></td>
</tr>
</tbody>
</table>
## II.6 Sterilization and Disinfection of Patient-Care Items and Devices

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A.</strong> Single-use devices are discarded after one use and not used for more than one patient</td>
<td>![ ] Yes ![ ] No</td>
<td></td>
</tr>
<tr>
<td><strong>B.</strong> Reusable critical and semicritical dental items and devices are cleaned and heat-sterilized according to manufacturer instructions between patient use</td>
<td>![ ] Yes ![ ] No</td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> If the manufacturer does not provide reprocessing instructions, the item or device may not be suitable for multi-patient use.</td>
<td>![ ] Yes ![ ] No</td>
<td></td>
</tr>
<tr>
<td><strong>C.</strong> Items are thoroughly cleaned according to manufacturer instructions and visually inspected for residual contamination before sterilization</td>
<td>![ ] Yes ![ ] No</td>
<td></td>
</tr>
<tr>
<td><strong>D.</strong> Food and Drug Administration (FDA)-cleared automated cleaning equipment (e.g., ultrasonic cleaner, instrument washer, washer-disinfector) is used to remove debris to improve cleaning effectiveness and decrease worker exposure to blood</td>
<td>![ ] Yes ![ ] No</td>
<td></td>
</tr>
<tr>
<td><strong>E.</strong> Work-practice controls that minimize contact with sharp instruments (e.g., long-handled brush) are used and appropriate PPE is worn (e.g., puncture- and chemical-resistant utility gloves) if manual cleaning is necessary</td>
<td>![ ] Yes ![ ] No</td>
<td></td>
</tr>
<tr>
<td><strong>F.</strong> After cleaning and drying, instruments are appropriately wrapped/packaged for sterilization (e.g., package system selected is compatible with the sterilization process being performed, hinged instruments are open, instruments are disassembled if indicated by the manufacturer)</td>
<td>![ ] Yes ![ ] No</td>
<td></td>
</tr>
<tr>
<td><strong>G.</strong> A chemical indicator is used inside each package. If the internal indicator is not visible from the outside, an exterior chemical indicator is also used on the package</td>
<td>![ ] Yes ![ ] No</td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> The chemical indicators may be integrated into the package design.</td>
<td>![ ] Yes ![ ] No</td>
<td></td>
</tr>
<tr>
<td><strong>H.</strong> Sterile packs are labeled at a minimum with the sterilizer used, the cycle or load number, the date of sterilization, and if applicable an expiration date</td>
<td>![ ] Yes ![ ] No</td>
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### II.6 Sterilization and Disinfection of Patient-Care Items and Devices

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<th>Elements To Be Assessed</th>
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</tr>
</thead>
<tbody>
<tr>
<td>I. FDA-cleared medical devices for sterilization are used according to manufacturer's instructions</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>J. A biologic indicator (i.e., spore test) is used at least weekly and with every load containing implantable items</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>K. Logs for each sterilizer cycle are current and include results from each load and comply with state and local regulations</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>L. After sterilization, dental devices and instruments are stored so that sterility is not compromised</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>M. Sterile packages are inspected for integrity and compromised packages are reprocessed before use</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>N. Instrument packs are not used if mechanical (e.g., time, temperature, pressure) or chemical indicators indicate inadequate processing (e.g., color change for chemical indicators)</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>O. The instrument processing area has a workflow pattern designed to ensure that devices and instruments clearly flow from high contamination areas to clean/sterile areas (i.e., there is clear separation of contaminated and clean workspaces)</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>P. Reusable heat sensitive semicritical items that cannot be replaced by a heat stable or disposable alternative are high-level disinfected according to manufacturer's instructions</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>Q. High-level disinfection products are used and maintained according to manufacturer instructions</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>R. Dental handpieces (including the low-speed motor) and other devices not permanently attached to air and waterlines are cleaned and heat-sterilized according to manufacturer instructions</td>
<td>❑ Yes ❑ No</td>
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</tbody>
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### II.6 Sterilization and Disinfection of Patient-Care Items and Devices

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<tbody>
<tr>
<td><strong>S.</strong> If digital radiography is used in the dental setting—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. FDA-cleared barriers are used to cover the sensor and barriers are changed between patients</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td>b. after the surface barrier is removed, the sensor is ideally cleaned and heat sterilized or high-level disinfected according to the manufacturer’s instructions. If the item cannot tolerate these procedures, then at a minimum, the sensor is cleaned and disinfected with an intermediate-level, EPA-registered hospital disinfectant</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
</tbody>
</table>

*Note:* Consult with manufacturers regarding compatibility of heat sterilization methods and disinfection products.

### II.7 Environmental Infection Prevention and Control

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A.</strong> Clinical contact surfaces are either barrier-protected or cleaned and disinfected with an EPA-registered hospital disinfectant after each patient. An intermediate-level (i.e., tuberculocidal claim) disinfectant is used if visibly contaminated with blood</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td><strong>B.</strong> Surface barriers are used to protect clinical contact surfaces that are difficult to clean (e.g., switches on dental chairs, computer equipment, connections to hoses) and are changed between patients</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td><strong>C.</strong> Cleaners and disinfectants are used in accordance with manufacturer instructions (e.g., dilution, storage, shelf-life, contact time, PPE)</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td><strong>D.</strong> Regulated medical waste is handled and disposed of according to local, state, and federal regulations</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
<tr>
<td><strong>E.</strong> DHCP engaged in environmental cleaning wear appropriate PPE to prevent exposure to infectious agents or chemicals (PPE can include gloves, gowns, masks, and eye protection)</td>
<td>❑ Yes ❑ No</td>
<td></td>
</tr>
</tbody>
</table>

*Note:* The correct type of PPE depends on infectious or chemical agent and anticipated type of exposure.
## II.8 Dental Unit Water Quality

<table>
<thead>
<tr>
<th>Elements To Be Assessed</th>
<th>Assessment</th>
<th>Notes/Areas For Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A.</strong> Dental unit waterline treatment products/devices are used to ensure water meets EPA regulatory standards for drinking water (i.e., ≤ 500 CFU/mL of heterotrophic water bacteria) for routine dental treatment output water</td>
<td>![Yes/No]</td>
<td></td>
</tr>
<tr>
<td><strong>B.</strong> Product manufacturer instructions (i.e., waterline treatment product, dental unit manufacturer) are followed for monitoring the water quality</td>
<td>![Yes/No]</td>
<td></td>
</tr>
<tr>
<td><strong>C.</strong> Sterile saline or sterile water is used as a coolant/irrigant when performing surgical procedures</td>
<td>![Yes/No]</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Use devices specifically designed for delivering sterile irrigating fluids (e.g., sterile bulb syringe, single-use disposable products, and sterilizable tubing).

**Note:** Examples of surgical procedures include biopsy, periodontal surgery, apical surgery, implant surgery, and surgical extractions of teeth.
Appendix B

Relevant Recommendations Published by CDC Since 2003

Administrative Measures

1. Develop and maintain written infection prevention policies and procedures appropriate for the services provided by the facility and based upon evidence-based guidelines, regulations, or standards.
2. Infection prevention policies and procedures are reassessed at least annually or according to state or federal requirements.
3. Assign at least one individual trained in infection prevention responsibility for coordinating the program.
4. Provide supplies necessary for adherence to Standard Precautions (e.g., hand hygiene products, safer devices to reduce percutaneous injuries, personal protective equipment).
5. Facility has system for early detection and management of potentially infectious persons at initial points of patient encounter.

References

2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings

Guide to Infection Prevention for Outpatient Settings: Minimum Expectations for Safe Care

Infection Prevention Education and Training

1. Maintain training records according to state and federal requirements.

Reference

2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings

Respiratory Hygiene/Cough Etiquette

1. Implement measures to contain respiratory secretions in patients and accompanying individuals who have signs and symptoms of a respiratory infection, beginning at point of entry to the facility and continuing throughout the visit.
2. Post signs at entrances with instructions to patients with symptoms of respiratory infection to—
   ■ Cover their mouths/noses when coughing or sneezing.
   ■ Use and dispose of tissues.
   ■ Perform hand hygiene after hands have been in contact with respiratory secretions.
3. Provide tissues and no-touch receptacles for disposal of tissues.
4. Provide resources for performing hand hygiene in or near waiting areas.
5. Offer masks to coughing patients and other symptomatic persons when they enter the dental setting.
6. Provide space and encourage persons with symptoms of respiratory infections to sit as far away from others as possible. If available, facilities may wish to place these patients in a separate area while waiting for care.
7. Educate DHCP on the importance of infection prevention measures to contain respiratory secretions to prevent the spread of respiratory pathogens when examining and caring for patients with signs and symptoms of a respiratory infection.
Safe Injection Practices

1. Prepare injections using aseptic technique in a clean area.
2. Disinfect the rubber septum on a medication vial with alcohol before piercing.
3. Do not reuse needles or syringes to enter a medication vial or solution, even when obtaining additional doses for the same patient.
4. Do not use single-dose (single-use) medication vials, ampules, and bags or bottles of intravenous solution for more than one patient.
5. Dedicate multidose vials to a single patient whenever possible.
6. If multidose vials will be used for more than one patient, they should be kept in a centralized medication area and should not enter the immediate patient treatment area to prevent inadvertent contamination.
7. If a multidose vial enters the immediate patient treatment area it should be dedicated for single-patient use and discarded immediately after use.
8. Date multidose vials when first opened and discard within 28 days unless the manufacturer specifies a shorter or longer date for that opened vial.

References

2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings

CDC: Injection Safety, Information for Providers
www.cdc.gov/injectionsafety/providers.html

Guide to Infection Prevention for Outpatient Settings: Minimum Expectations for Safe Care

Sterilization and Disinfection of Patient-Care Items and Devices

1. Have manufacturer instructions for reprocessing reusable dental instruments/equipment readily available, ideally in or near the reprocessing area.
2. Label sterilized items with the sterilizer used, the cycle or load number, the date of sterilization, and (if applicable) the expiration date.
3. Ensure routine maintenance for sterilization equipment is performed according to manufacturer instructions and maintenance records are available.

Reference

Appendix C

Selected References and Additional Resources by Topic Area

Administrative Measures

Guidelines for Infection Control in Dental Health-Care Settings—2003
www.cdc.gov/mmwr/PDF/rr/rr5217.pdf
   Table 1: Suggested work restrictions for health care personnel infected with or exposed to major infectious diseases in health care settings, in the absence of state and local regulations

2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings

Guideline for Infection Control in Healthcare Personnel, 1998
www.cdc.gov/hicpac/pdf/InfectControl98.pdf

Immunization of Health-Care Personnel: Recommendations of the Advisory Committee on Immunization Practices (ACIP)
www.cdc.gov/mmwr/pdf/rr/rr6007.pdf

Updated U.S. Public Health Service Guidelines for the Management of Occupational Exposures to HIV and Recommendations for Postexposure Prophylaxis
http://stacks.cdc.gov/view/cdc/20711

Updated U.S. Public Health Service Guidelines for the Management of Occupational Exposures to HBV, HCV, and HIV and Recommendations for Postexposure Prophylaxis
www.cdc.gov/mmwr/PDF/rr/rr5011.pdf

CDC Guidance for Evaluating Health-Care Personnel for Hepatitis B Virus Protection and for Administering Postexposure Management
www.cdc.gov/mmwr/PDF/rr/rr6210.pdf

Infection Prevention Education and Training

Guidelines for Infection Control in Dental Health-Care Settings—2003
www.cdc.gov/mmwr/PDF/rr/rr5217.pdf

2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings

Organization for Safety, Asepsis, and Prevention (OSAP) Knowledge Center
http://www.osap.org/?page=KnowledgeCenter

Association for Professionals in Infection Control and Epidemiology (APIC)
Practice Guidance for Infection Prevention
http://apic.org/Professional-Practice/Overview

Dental Health Care Personnel Safety

Guidelines for Infection Control in Dental Health-Care Settings—2003
www.cdc.gov/mmwr/PDF/rr/rr5217.pdf

Guideline for Infection Control in Healthcare Personnel, 1998
www.cdc.gov/hicpac/pdf/InfectControl98.pdf
Program Evaluation

Guidelines for Infection Control in Dental Health-Care Settings — 2003
www.cdc.gov/mmwr/PDF/rr/rr5217.pdf

Table 5: Examples of methods for evaluating infection control programs

Example of an audit tool used by federal surveyors in ambulatory surgical centers (including dental)

Measuring Hand Hygiene Adherence: Overcoming the Challenges
www.cdc.gov/handhygiene/Measurement.html

Summary of Infection Prevention Practices in Dental Settings: Basic Expectations for Safe Care
www.cdc.gov/oralhealth/infectioncontrol/index.htm

Appendix A: Infection Prevention Checklist for Dental Settings: Basic Expectations for Safe Care

Standard Precautions

Guidelines for Infection Control in Dental Health-Care Settings — 2003
www.cdc.gov/mmwr/PDF/rr/rr5217.pdf

2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings

Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006

jada.ada.org/article/S0002-8177(14)61533-6/abstract

Hand Hygiene

Guidelines for Infection Control in Dental Health-Care Settings — 2003
www.cdc.gov/mmwr/PDF/rr/rr5217.pdf

Table 2: Hand-hygiene methods and indications

Guideline for Hand Hygiene in Health-Care Settings
www.cdc.gov/mmwr/PDF/rr/rr5116.pdf

CDC Hand Hygiene in Healthcare Settings Educational Materials
www.cdc.gov/handhygiene/
Personal Protective Equipment

*Guidelines for Infection Control in Dental Health-Care Settings*—2003
www.cdc.gov/mmwr/PDF/rr/rr5217.pdf

*2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings*

Guidance for the Selection and Use of Personal Protective Equipment in Healthcare Settings: Slides and Posters
www.cdc.gov/hai/prevent/ppe.html

Respiratory Hygiene/Cough Etiquette

*2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings*

CDC Influenza (Flu) Resources for Health Care Facilities
www.cdc.gov/flu/professionals/infectioncontrol/

CDC Respiratory Hygiene/Cough Etiquette in Healthcare Settings
www.cdc.gov/flu/professionals/infectioncontrol/resphygiene.htm

Sharps Safety

*Guidelines for Infection Control in Dental Health-Care Settings*—2003
www.cdc.gov/mmwr/PDF/rr/rr5217.pdf

*Workbook for Designing, Implementing, and Evaluating a Sharps Injury Prevention Program*
www.cdc.gov/sharpsafety

CDC Sample Screening and Device Evaluation Forms for Dentistry
www.cdc.gov/OralHealth/infectioncontrol/forms.htm

Safe Injection Practices

*Guidelines for Infection Control in Dental Health-Care Settings*—2003
www.cdc.gov/mmwr/PDF/rr/rr5217.pdf

*2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings*

CDC Injection Safety: Information for Providers—includes a list of frequently asked questions for providers and injection safety training video.
www.cdc.gov/injectionsafety

*One and Only Campaign*
www.oneandonlycampaign.org
Sterilization and Disinfection of Patient-Care Items and Devices

Guidelines for Infection Control in Dental Health-Care Settings—2003
www.cdc.gov/mmwr/PDF/rr/rr5217.pdf
Table 4: Infection-control categories of patient-care instruments
Appendix C: Methods for Sterilizing and Disinfecting Patient-Care Items and Environmental Surfaces


Resources to assist in the event of a reprocessing error/failure
CDC Health Care Associated Infections, Outbreaks and Patient Notifications
www.cdc.gov/hai/outbreaks/outbreak-resources.html

Environmental Infection Prevention and Control

Guidelines for Infection Control in Dental Health-Care Settings—2003
www.cdc.gov/mmwr/PDF/rr/rr5217.pdf
Guidelines for Environmental Infection Control in Health-Care Facilities
www.cdc.gov/hicpac/pdf/guidelines/eic_in_HCF_03.pdf

EPA Medical Waste Frequent Questions
www.epa.gov/osw/nonhaz/industrial/medical/mwfaqs.htm
EPA Where You Live—State Medical Waste Programs and Regulations
www.epa.gov/osw/nonhaz/industrial/medical/programs.htm

Dental Unit Water Quality

Guidelines for Infection Control in Dental Health-Care Settings—2003
www.cdc.gov/mmwr/PDF/rr/rr5217.pdf

CDC Boil-Water Advisories and the Dental Office
http://www.cdc.gov/oralhealth/infectioncontrol/faq/dentalunitwaterquality.htm
Sealing pits and fissures of permanent molars in children and adolescents is effective in controlling dental caries


Svetlana Tikhonova, DMD, MSc, PhD

Systematic review conclusion. Sealants to prevent occlusal caries in permanent molars are recommended, but the benefits in different caries risk populations and types of sealants have yet to be established.

Critical summary assessment. Resin-based sealants in permanent molars reduces risk of experiencing caries up to 48 months compared with permanent molars without sealants; however, after longer follow-up, the quantity and quality of the evidence is reduced.

Evidence quality rating. Good.

Clinical question. In children and adolescents with high and low risk of developing caries, does the application of different types of pit-and-fissure sealants in permanent teeth result in caries control compared with no treatment and compared by types of material?

Review methods. Two of the authors independently searched 9 databases including gray literature for publications from 1946 to September 2012. An additional search of ongoing trials as well as reference lists was done. There were no language or publication restrictions. The included randomized or quasi-randomized controlled trials were of at least 12 months duration to compare sealants for preventing caries of occlusal or approximal surfaces of premolars or molars. The comparison group was children and adolescents under age 20 years who did not receive sealants of any type.

The specific outcome measure was the incidence of occlusal caries reaching the dentin of permanent molars. The quality of the evidence was assessed using Grading of Recommendations Assessment, Development and Evaluation (GRADE) methods. If clarification of the studies was needed, the reviewers contacted the authors. The meta-analyses were conducted, and the incidence of dental caries was expressed in odds ratio (OR) for the meta-analysis or mean difference.

Main results. Thirty-four trials were included, but only 12 trials evaluated the effects of sealants compared with no sealants (2,575 participants); 21 trials evaluated 1 type of sealant compared with another (3,202 participants); and 1 trial evaluated 2 different types of sealant and no sealants (752 participants). The auto-polymerized resin-based and visible-light–polymerized resin-based sealant materials were mainly used in the included trials. Trials rarely reported exposure to fluoride of the participants or the baseline caries prevalence. Six trials were deemed at low risk of bias and, therefore, were used in the meta-analysis to compare controls without sealants with those with resin-based sealants. The results of this meta-analysis showed that resin-based sealants prevented caries in permanent first molars in children aged 5 to 10 years: at 2 years of follow-up, OR = 0.12 (95% confidence interval [CI], 0.07-0.19). Assuming that 40% of the control tooth surfaces were decayed during 2 years of follow-up (400 carious teeth per 1,000), then applying a resin-based sealant will reduce the proportion of the carious surfaces to 6.25% (95% CI, 3.84-9.63%); assuming that 70% of the control tooth surfaces were decayed (700 carious teeth per 1,000), then applying a resin-based
sealant will reduce the proportion of the carious surfaces to 18.92% (95% CI, 12.28–27.18%). This caries-preventive effect was maintained at longer follow-up but both the quality and quantity of the evidence was reduced. The average percentage of sealant loss increased with time: 19%, 29%, 33%, and 41% for 12, 24, 36, and 48 months, respectively. There was insufficient evidence (only 1 study with unclear risk of bias) to make any conclusions whether glass ionomer sealants prevent caries compared with no sealants at 24-month follow-up. Several different comparisons were made according to type of sealant, outcome measure, and duration of follow-up. The relative effectiveness of different types of sealants in this review remained inconclusive because of unclear study settings, lack of information on caries prevalence and caries risk of the study population, and different baseline conditions of sealed surfaces. Therefore, the authors did not feel they had adequate data to make the necessary comparisons.

**Conclusions.** Sealing the permanent molars of children and adolescents reduces caries up to 48 months when compared with permanent molars without sealants; after longer follow-up, the evidence is weak. The relative effectiveness of different types of sealants has yet to be established.

Funding was provided by the National Institute for Health and Welfare, Tampere, Finland; The Manchester, Academic Health Science Centre, Manchester, United Kingdom; the National Institute for Health Research Manchester Biomedical Research Centre, Manchester, United Kingdom; Centers for Disease Control and Prevention, Atlanta, GA; Cochrane Oral Health Group Global Alliance, Manchester, United Kingdom; and National Institute for Health Research, London, United Kingdom.

**COMMENTARY**

**Importance and context.** Numerous studies have reported pit-and-fissure sealants as an effective approach for preventing and controlling caries lesions in children. Strong evidence on effectiveness of different types of sealants in different caries prevalence populations is needed.

**Strengths and weaknesses of the systematic review.** This Cochrane review (2013) is the most recent and updated version of the earlier reviews (1999, 2004, and 2008). A broad search of the literature with no language or publication restrictions was done in duplicate. Included and excluded studies were provided, and reasons for exclusion were indicated. Only studies with full-text reports were considered. The scientific quality of the included studies was evaluated. The homogeneity assessment was conducted for combining the studies and clinical appropriateness of combining studies was taken into consideration. Because of heterogeneity of the comparisons, the random effects model was used for the meta-analysis. The sensitivity analyses were performed to evaluate the effect of the risk of bias grading on the results. The likelihood of publication bias was assessed but not presented in graphs or statistical tests. The conflict of interest was stated. The studies with both sealant application methods (direct and after tooth surface preparation) were included.

**Strengths and weaknesses of the evidence.** The strength of this systematic review is based on inclusion of randomized or quasi-randomized clinical trials with 85% of studies comparing sealant versus no treatment with appropriate random sequence generation and allocation concealment. Masking of outcome assessors was not achieved; in 69% of studies comparing sealant versus no treatment, a partial masking of examiners was reported. The attrition bias for the studies comparing sealant versus no treatment were low for 12- and 24-month follow-up, and they were increasing at 36 months follow-up and higher. Seventy-seven percent of studies comparing sealants versus no treatment had low risk of bias for cointerventions. The retention of resin-based sealants when compared with a control without sealants at 12- and 24-month follow-up was good. Weaknesses included the baseline caries prevalence being reported in only 2 studies comparing sealants versus no treatment. Background exposure to fluoride was rarely reported. The indications for sealant placement were not clear because of the diversity in outcome measures and follow-up times between the studies. In some studies, there was a lack of information on diagnostic method used and its reliability assessment. Only 2 studies reported adverse effect of sealants.

**Implications for dental practice.** Application of resin-based pit-and-fissure sealants in permanent teeth in children and adolescents has clinical importance because it facilitates the control of the caries process and prevents further involvement on the tooth in restoration cycle. Because of lack of the data on caries risk status of children in this systematic review, the relative effectiveness of sealants in different caries risk groups remains a very important issue to be determined. With the slowing caries rate in children, there are contemporary concerns about the need to seal teeth in low-risk populations.

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Disclosure. Dr. Tikhonova did not report any disclosures.

These summaries, published under the auspices of the American Dental Association Center for Evidence-Based Dentistry, are prepared by practitioners trained in critical appraisal of published systematic reviews who work under the mentorship of experts. The summaries are not intended to, and do not, express, imply, or summarize standards of care, but rather provide a concise reference for dentists to aid in understanding and applying evidence from the referenced systematic review in making clinically sound decisions as guided by their clinical judgment and by patient needs.

For more information on the evidence quality rating provided above and additional critical summaries, please visit http://ebd.ada.org.

Dental Sealants Prevent Cavities

Effective protection for children

Dental sealants are thin coatings that when painted on the chewing surfaces of the back teeth (molars) can prevent cavities for many years. School-age children (ages 6-11) without sealants have almost 3 times more 1st molar cavities than those with sealants. Although the overall number of children with sealants has increased over time, low-income children are 20% less likely to have them and 2 times more likely to have untreated cavities than higher-income children. Untreated cavities can cause pain, infection, and problems eating, speaking, and learning. States can help millions more children prevent cavities by starting or expanding programs that offer dental sealants in schools.

State officials can:
- Target school-based sealant programs to areas where children are at higher risk for cavities. Track the number of schools and children participating in sealant programs.
- Implement policies that allow school-based sealant programs to operate in the most cost-effective manner.
- Help schools connect to Medicaid and the Children’s Health Insurance Program (CHIP), local health department clinics, community health centers, and dental providers in the community to foster more use of sealants and reimbursement of services.

Want to learn more?
www.cdc.gov/vitalsigns/dental-sealants
Problem:

About 7 million low-income children need sealants.

What are sealants?
- Sealants are thin coatings painted on teeth to protect them from cavities. They flow into the deep grooves of teeth and harden immediately so a child is able to chew right away.
- Sealants prevent the most cavities when applied soon after permanent molars come into the mouth (around age 6 for 1st molars and age 12 for 2nd molars).
- Sealants can be applied by a dentist, dental hygienist, or other qualified dental professional, depending on state law and regulations. This can be done in dental offices or using portable dental equipment in community settings like a school.

Why use sealants?
- Sealants are a quick, easy, and painless way to prevent most of the cavities children get in the permanent back teeth, where 9 in 10 cavities occur.
- Once applied, sealants protect against 80% of cavities for 2 years and continue to protect against 50% of cavities for up to 4 years.
- Sealants can eliminate the need for expensive and invasive treatments like dental fillings or crowns.
- Applying sealants in schools for about 7 million low-income children who don’t have them could save up to $300 million in dental treatment costs.

Dental sealants can prevent cavities when applied to molar teeth.

School-based programs are one way to reach millions of children with sealants to prevent cavities.
School-based sealant programs are effective but underused.

**Sealant Use**

**Disparities are decreasing over time**

The number of low-income children with sealants increased by about 70% from 1999-2004 to 2011-2014, and the number of higher-income children with sealants increased by 23%. The increase in sealants among low-income children prevented almost 1 million cavities.*


**Cavities**

**Disparities still exist**

Low-income children without sealants have about 60% more cavities in their 1st permanent molars than higher-income children.

What Can Be Done?

The Federal government is

- Classifying pediatric dental services as an essential health benefit to be covered by dental insurance as part of the Affordable Care Act.
- Matching state costs for applying dental sealants for all children enrolled in Medicaid/CHIP and tracking program performance.
- Encouraging community health centers with dental programs to start or expand school-based sealant programs to help more low-income children.
- Helping fund states to increase the number of dental sealant programs.
- Providing incentives for dentists to practice in underserved areas to increase access to dental services.

State officials can

- Target school-based sealant programs to the areas of greatest need. Track the number of schools and children participating in sealant programs.
- Implement policies that deliver school-based sealant programs in the most cost-effective manner.
- Help schools connect to Medicaid and CHIP, local health department clinics, community health centers, and dental providers in the community to foster more use of sealants and reimbursement of services.

Dental care providers can

- Apply sealants to children at highest risk of cavities, including those covered by Medicaid/CHIP. Donate time and resources to a school-based dental sealant program.
- Learn about school-based dental sealant programs and their effectiveness.
- Accept children into their practice who are identified as needing more services when they receive sealants in schools.

School administrators can

- Work with the local or state public health programs and local dental providers to start school-based sealant programs.
- Support having sealant programs in schools and promote its benefits to teachers, staff, and parents. Help children enroll in sealant programs by putting information for parents in registration packets in the beginning of the school year.
- Encourage schools to develop relationships with local dental offices and community dental clinics to help children get dental care.

Parents can

- Ask your child’s dentist to apply sealants when appropriate.
- Sign your child up to participate in a school-based sealant program. If your school does not have a sealant program, ask them to start one.
- Find a dentist if your child needs one. Use the Insure Kids Now Dentist Locator: http://bit.ly/2dwnU5E
Sealants for preventing and arresting pit-and-fissure occlusal caries in primary and permanent molars

A systematic review of randomized controlled trials—a report of the American Dental Association and the American Academy of Pediatric Dentistry

John T. Wright, DDS, MS; Malavika P. Tampi, MPH; Laurel Graham, MLS; Cameron Estrich, MPH; James J. Crall, DDS, MS, ScD; Margherita Fontana, DDS, PhD; E. Jane Gillette, DDS; Brian B. Nový, DDS; Vineet Dhar, BDS, MDS, PhD; Kevin Donly, DDS, MS; Edmond R. Hewlett, DDS; Rocio B. Quinonez, DMD, MS, MPH; Jeffrey Chaffin, DDS, MPH, MHA; Matt Crespin, MPH, RDH; Timothy Iafolla, DMD, MPH; Mark D. Siegal, DDS, MPH; Alonso Carrasco-Labra, DDS, MS, PhD(c)

Caries prevalence has declined in developed countries over the past several decades; however, many populations within these nations still carry a large burden of this disease.1 National Health and Nutrition Examination Survey 2011-2012 data indicated that, in the United States, nearly one-fourth of children and over one-half of adolescents experienced dental caries in their permanent teeth. The purpose of this review was to summarize the available clinical evidence regarding the effect of dental sealants for the prevention and management of pit-and-fissure occlusal carious lesions in primary and permanent molars, compared with a control without sealants, with fluoride varnishes, or with other head-to-head comparisons.

Type of Studies Reviewed. The authors included parallel and split-mouth randomized controlled trials that included at least 2 years of follow-up, which they identified using MEDLINE (via PubMed), Embase, LILACS, the Cochrane Central Register of Controlled Trials, and registers of ongoing trials. Pairs of reviewers independently conducted the selection of studies, data extraction, risk of bias assessments, and quality of the evidence assessments by using the Grading of Recommendations Assessment, Development and Evaluation approach.

Results. Of 2,869 records screened, the authors determined that 24 articles (representing 23 studies) proved eligible. Moderate-quality evidence suggested that participants who received sealants had a reduced risk of developing carious lesions in occlusal surfaces of permanent molars compared with those who did not receive sealants (odds ratio [OR], 0.15; 95% confidence interval [CI], 0.08–0.27) after 7 or more years of follow-up. When the authors compared studies whose investigators had compared sealants with fluoride varnishes, they found that sealants reduced the incidence of carious lesions after 7 or more years of follow-up (OR, 0.19; 95% CI, 0.07–0.51); however, this finding was supported by low-quality evidence. On the basis of the evidence, the authors could not provide a hierarchy of effectiveness among the studies whose investigators had conducted head-to-head comparisons. The investigators of 2 trials provided information about adverse events, but they did not report any adverse events.

Conclusions and Practical Implications. Available evidence suggests that sealants are effective and safe to prevent or arrest the progression of noncavitated carious lesions compared with a control without sealants or fluoride varnishes. Further research is needed to provide information about the relative merits of the different types of sealant materials.

Key Words. Glass ionomer sealants; resin-based sealants; caries prevention; caries arrest; pit-and-fissure sealants; systematic review.

JADA 2016;147(8):631-645

http://dx.doi.org/10.1016/j.adaj.2016.06.003
adolescents experienced dental carious lesions in their permanent teeth. ² Occlusal surfaces, especially those on permanent molars, contain grooves called pits and fissures that can trap debris and microorganisms, thereby increasing the risk of developing dental carious lesions. Indeed, the caries that are found in the adolescent population are represented disproportionately in the pits and fissures of teeth compared with the smooth surfaces. ³ Fluorides and other caries preventive approaches (for example, mechanical plaque control) seem to be less effective for preventing carious lesions in pit-and-fissure surfaces compared with smooth surfaces. ⁴ Pit-and-fissure sealants, or simply sealants, were developed to help manage these sites of dental stagnation that are resistant to other therapeutic approaches and contribute to a significant portion of caries disease burden in the population. Sealants are an underused therapy; only 30% of children 6 to 8 years old have at least 1 dental sealant. ⁵

Sealants are dental materials that dentists apply to the pit-and-fissure surfaces of teeth. The sealant material penetrates pits and fissures and then hardens, acting as a physical barrier that stops or inhibits the ingress of bacteria and nutrients. Researchers conducted the first clinical trials in the late 1960s and early 1970s using a variety of materials. Today there are multiple commercially available sealant materials, including resin-based sealants such as urethane dimethacrylate or bisphenol A-glycidyl methacrylate monomers that are polymerized by means of either a chemical activation-initiation or a light activation system. Glass ionomer (GI) cements or GI sealants, resin-modified resins. We classify these dental materials as any of the types of GI sealants described previously, irrespective of the application technique. The authors of 1 review reported that sealants were effective in preventing occlusal and proximal carious lesions in the molars of children when compared with controls without sealants. ⁷ The authors of this review also reported inconclusive and inconsistent results related to the potential superiority of any of the sealant materials in head-to-head comparisons. ⁷ The authors of another systematic review suggested that sealants may be more effective than fluoride varnishes in preventing occlusal carious lesions in molars in children, but the quality of the evidence was low. ⁶ The investigators of both of these systematic reviews ⁶,⁷ reported that the authors of most of the included studies did not mention adverse events, and even when authors did mention adverse events, they did not report any adverse events that had occurred in their studies. ⁶,⁷

The purpose of this review was to summarize the available evidence regarding the effect of dental sealants for the prevention of pit-and-fissure occlusal caries in primary and permanent molars on children, adolescents, and adults compared with a control without sealants, with fluoride varnishes, or with another head-to-head comparison to inform the development of a joint evidence-based clinical practice guideline by the American Dental Association and the American Academy of Pediatric Dentistry. ⁸

METHODS
This report follows the guidance of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement. ⁹

Selection criteria for the studies in this review.

Type of studies. We included parallel and split-mouth randomized controlled trials (RCTs) with at least 2 years of follow-up. We excluded quasirandomized trials, nonrandomized trials, and observational studies.

Type of participants. We included studies that involved children, adolescents, and adults from the general population who did or did not have a history of carious lesions and who had either a sound occlusal surface or a noncavitated carious lesion in primary and permanent molars.

Type of interventions. For this systematic review, we defined 4 categories of sealant materials: resin-based sealants, GI cements or GI sealants, resin-modified GI sealants, and polyacid-modified resins. We classified resin-modified GI sealants as a subcategory of the GI sealants category and polyacid-modified resins as a subcategory of the resin-based sealants category. ⁵ We defined “intervention” as any of the 4 types of sealant materials described previously, irrespective of the application technique. We excluded studies whose investigators used sealant materials that were not

commercially available at the time of this review. We defined “comparison” as any type of sealant material irrespective of the application technique, the nonplacement of sealants, or the use of fluoride varnishes.

**Type of outcome measures.** We defined “caries incidence” as the identification of a new carious lesion on the occlusal surface of a primary or permanent molar that compromised dentin tissue. We defined “lack of retention” as the complete detachment or retention loss of the sealant material from the grooves and pits in the occlusal surface of a tooth with no macroscopically visible sealant material. We defined “adverse effects” as any potential adverse effect defined by the authors of the primary studies. For all outcomes, we grouped the studies into 3 categories according to the length of follow-up: 2 to 3 years, 4 to 7 years, and 7 or more years.

**Search methods for the identification of studies.**

**Electronic databases.** We searched MEDLINE (via PubMed), Embase, LILACS, and the Cochrane Central Register of Controlled Trials (CENTRAL) from January 1971 to May 2013. We searched MEDLINE (via PubMed) and the Cochrane Central Register of Controlled Trials (CENTRAL) from June 2013 to May 2016. We used a combination of key words and controlled vocabulary that we adapted for each electronic database. We used filters, such as the Cochrane Highly Sensitive Search Strategy, for identifying randomized trials (Appendix, available online at the end of this article).10

**Other type of resources.** We searched ClinicalTrials.gov to identify completed or ongoing RCTs that were not yet published and indexed in the regular electronic indices. We also screened the reference lists of included studies from previous systematic reviews to ensure that we had not omitted relevant studies. We did not exclude any studies on the basis of the status or language of publication.

**Data collection and analysis.**

**Selection of studies.** In the first stage, 2 reviewers (M.T., L.G.) independently screened the titles and abstracts of all retrieved references by using a standardized form. Because they used an inclusive criterion, when the reviewers disagreed on the eligibility status for a particular reference, they included the citation in question at this stage and resolved the disagreement at the full-text screening stage. In the second stage, 2 reviewers independently screened the full text of all potentially eligible studies. They resolved any disagreement by means of discussion. When consensus was elusive, a third reviewer (C.E.), acting as an arbiter, decided final eligibility.

**Data extraction and management.** Using a standardized form, 2 reviewers (M.T., L.G.) independently extracted data from all the included studies. The form included instructions to extract the main characteristics of the studies, including the type of study design (parallel, split-mouth), population (age, sex, selection criteria, caries history, clinical diagnosis of the occlusal surface to be sealed), type of sealant material and the comparison (nonuse of sealant or an active comparator), and the outcomes (specific definition from the primary study and results). When these reviewers identified discrepancies that they were unable to clarify, a third reviewer (C.E.) acted as arbiter.

**Assessment of the risk of bias of included studies.** Two reviewers (M.T., A.C.L.) independently conducted an assessment of the risk of bias for each included study by using the Cochrane risk of bias tool.11 We assessed the following types of bias in each study: selection bias (Was allocation randomized and concealed to ensure comparability between groups?), detection bias (Were the patients and outcome assessors unaware of which treatment was applied?), attrition bias (Were dropout rates sufficiently low to ensure that groups were still comparable at follow-up?), reporting bias (Did investigators selectively report outcomes?), and other sources of bias. For each domain, we determined whether a study had a high, low, or unclear risk of bias. We considered randomization sequence generation and allocation concealment to be the most important domains for the overall assessment of risk of bias. We resolved any disagreements by means of discussion until we reached consensus.

**Measures of treatment effect and missing data.** We analyzed caries incidence, lack of retention, and adverse events as dichotomous outcomes. For studies in which the investigators reported sealants as being fully retained, partially retained, and not retained, we grouped the fully and partially retained events and compared them with the sealants that were not retained to create the estimate. We calculated odds ratios (OR) and 95% confidence intervals (CI) for both outcomes. For each study, we calculated the proportion of missing participant data, and we determined to what extent the amount of missing data was substantial enough to change the magnitude and direction of the estimates to the point of dramatically changing the conclusions, as suggested by Akl and colleagues.12 Otherwise, we used complete case analysis.

**Assessment of heterogeneity.** We conducted the assessment of heterogeneity by following the guidance of the Cochrane Handbook for Systematic Reviews of Intervention.13 We used the $\chi^2$ test to determine the presence of statistical heterogeneity, and we set the level of significance at .1. In addition, we quantified the amount of heterogeneity among studies using the $I^2$ statistic, in which we considered a value of $I^2$ 40% or less to be unimportant heterogeneity, a value of $I^2$ from 30% through 60% to be moderate heterogeneity, a value of $I^2$ from 50% through 90% to be substantial heterogeneity, and a value of $I^2$ from 70% through 100% to be considerable heterogeneity.

**Assessment of publication bias.** We conducted the assessment of publication bias by following the recommendations from the Cochrane Handbook for Systematic Reviews of Intervention.14 If we noted that an outcome was informed by more than 10 studies, then we explored publication bias by using funnel plots.
TABLE 1

Levels of quality of evidence (certainty in the evidence).*

<table>
<thead>
<tr>
<th>QUALITY LEVEL</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>We are very confident that the true effect lies close to that of the estimate of the effect</td>
</tr>
<tr>
<td>Moderate</td>
<td>We are moderately confident in the effect estimate; the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different</td>
</tr>
<tr>
<td>Low</td>
<td>Our confidence in the effect estimate is limited; the true effect may be substantially different from the estimate of the effect</td>
</tr>
<tr>
<td>Very Low</td>
<td>We have very little confidence in the effect estimate; the true effect is likely to be substantially different from the estimate of the effect</td>
</tr>
</tbody>
</table>

* Reproduced with permission of the publisher from Balshem and colleagues.18

Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach.57 With the GRADE approach, RCTs start as high-quality evidence; however, the quality or certainty in the body of evidence decreases to moderate-, low-, or very low–quality evidence if serious or very serious issues related to risk of bias, imprecision, inconsistency, indirectness, and publication bias are present (Table 1).58 Two reviewers (M.T., A.C.L.) independently conducted these evaluations.

RESULTS

Results of the search. The search process resulted in 2,869 references, which we screened to assess their titles and abstracts; we excluded 2,419 references at that stage of the search process. Next, we excluded 426 articles, which we had assessed by means of full-text screenings, and we included 24 articles,19-41 which represented 23 studies, in this review (Figure 1).

Characteristics of included studies. We included 24 articles (representing 23 studies) published from 1976 through 2016,19-41 whose investigators had reported data related to the effectiveness of sealants compared with a control without sealants,19-26 fluoride varnishes,20,22,27 or other head-to-head comparisons.28-40 Nine studies’ investigators used a parallel design, whereas 14 studies’ investigators used a split-mouth design.19,21,22,24,26,28,31,33,35,39,41 Table 2 summarizes the characteristics of the included populations, which investigators described as including children and adolescents aged 3 to 16 years who were living in settings with and without water fluoridation. We did not identify any studies that met the selection criteria whose investigators had provided information about the effect of sealants in an adult population.

Risk of bias of included studies. Poor quality of reporting of the included studies prevented us from conducting a complete assessment of the risk of bias. For most of the studies, we assessed the key 3 domains of random sequence generation, allocation concealment, and masking of participants and personnel as having an unclear risk of bias. Of these 3 domains, we determined that allocation concealment was the most serious and underreported methodological issue (Figure 2).

Effects of the interventions. Comparison 1. Sealants versus nonuse of sealants. Caries incidence. The results of 9 studies19-28 (3,542 participants) informed the comparison and outcome for the 2- to 3-year follow-up category. In relative terms, participants who received sealants reduced their risk of developing new carious lesions by 76% (odds ratio [OR], 0.24; 95% confidence interval [CI], 0.19-0.30; P < .00001) compared with participants who did not receive sealants. The heterogeneity was moderate (χ² = 10; I² = 41%); however, the investigators of all of the individual studies reported the same direction of effect with an overlap of CIs (eFigure 1, available online at the end of this article). In a

Data synthesis. Investigators of RCTs who measured the effectiveness of interventions to prevent carious lesions typically used 1 of 2 designs: split-mouth or parallel. In RCTs whose investigators used a parallel design, the investigators allocated study participants to receive either the experimental treatment or a control. In split-mouth trials, the investigators randomly assigned 1 of 2 treatments (for example, sealant versus no sealant) to the same type of tooth on the right and left sides of the participant’s mouth. One advantage of conducting split-mouth trials is that these types of RCTs minimize variability among study participants, as the intervention and control teeth are in the same person’s mouth. One potential issue, however, is that the preventive benefits of the intervention may carry over to the control teeth. We judged these carryover effects to be minimal for sealants, and therefore, we pooled the findings from studies whose investigators had used each of these designs to create a single effect estimate by using the methodology proposed by Lesaffre and colleagues15 and Elbourne and colleagues.16 We used Review Manager (RevMan), Version 5.3 (Cochrane Collaboration) to conduct the analysis. To obtain the pooled estimate, we used the generic inverse-variance method with a random-effects model. When we included fewer than 4 studies in the meta-analysis, we used a fixed-effects model.

Subgroup analysis. We conducted subgroup analysis to determine whether the studies whose investigators had enrolled participants with noncavitated pit-and-fissure occlusal carious lesions, sound occlusal surfaces, and those who had both (that is, a population who had a mix of both sound occlusal surfaces and noncavitated carious lesions) had different treatment effects. For the interaction test, we used a level of significance of .05.

Assessment of the quality of the evidence. We determined the quality of the evidence (certainty in the estimates of effect) for each outcome by using the
subgroup analysis conducted to determine whether the treatment effect differed among studies with patients who had noncavitated occlusal carious lesions, sound occlusal surfaces, and a population with mixed features, we did not find statistically significant results (interaction test \( P = .58 \)). We assessed the quality of the evidence for this outcome as moderate, owing to serious issues related to risk of bias (Table 3).

The results of 3 studies \(^{20,21,23} \) (752 participants) informed the comparison and outcome for the 4- to 7-year follow-up category. In relative terms, participants who received sealants had a reduction in the risk of developing new carious lesions by 79% (OR, 0.21; 95% CI, 0.10-0.44; \( P < .0001 \)) compared with participants who did not receive sealants (eFigure 2, available online at the end of this article). Because the investigators of all 3 of these studies included only participants with sound occlusal surfaces, we did not perform a subgroup analysis. Serious issues of inconsistency (\( \chi^2 P = .01; I^2 = 77\% \)) and risk of bias warranted us to determine that low-quality evidence informed this outcome (Table 3).

The results of 2 studies \(^{20,23} \) (446 participants) informed the comparison and outcome for the 7 or more years of follow-up category. In relative terms, participants who received sealants had a reduction in the risk of developing new carious lesions by 85% (OR, 0.15; 95% CI, 0.08-0.27; \( P < .00001 \)) compared with participants who did not receive sealants (eFigure 3, available online at the end of this article). The heterogeneity was moderate to high (\( \chi^2 P = .16; I^2 = 50\% \)); however, the investigators of all of the individual studies found the same direction of effect with an overlap of CIs. Because the investigators of the 2 studies included only participants with sound occlusal surfaces, we did not perform a subgroup analysis. We assessed the quality of the evidence for this outcome as moderate, owing to serious issues related to risk of bias (Table 3).

Lack of retention. The nature of the comparison did not allow us to obtain information to compare the use versus the nonuse of sealants.

**Comparison 2. Sealants versus fluoride varnishes.**

Caries incidence. The results of 3 studies \(^{20,22,27} \) (1,715 participants) informed the comparison and outcome for the 2- to 3-year follow-up category. In relative terms, participants who received sealants had a 73% reduction in the risk of developing new carious lesions (OR, 0.27; 95% CI, 0.11-0.69; \( P = .006 \)) compared with participants who received fluoride varnishes (eFigure 4, available online at the end of this article). In a subgroup analysis conducted to determine whether the treatment effect differed among studies with patients having noncavitated occlusal carious lesions, sound occlusal surfaces, and a population with mixed features, we found statistically significant results (interaction test \( P = .04 \)); however, this subgroup analysis did not explain the heterogeneity of the results. The investigators of both subgroups of studies with sound occlusal surfaces (OR, 0.19; 95% CI, 0.07-0.47; \( P = .0004 \)) and with a mixed population of participants with and without noncavitated carious lesions (OR, 0.66; 95% CI, 0.30-1.44; \( P = .3 \)) found that there was a beneficial effect when using sealants; however, this difference was not statistically significant in the latter study. \(^{22} \) We assessed the quality of the evidence for this outcome as low, owing to serious issues related to inconsistency (\( \chi^2 P = .002; I^2 = 88\% \)) and risk of bias (eTable 1, available online at the end of this article).

The results of 2 studies \(^{20,27} \) (472 participants) informed the comparison and outcome for the 4- to 7-year follow-up category. In relative terms, participants who received sealants had an 81% reduction in the risk of developing new carious lesions (OR, 0.19; 95% CI, 0.07-0.51; \( P = .0008 \)) compared with participants who received fluoride varnishes (eFigure 5, available online at the end of this article). Because the investigators of the 2 studies included only participants with sound occlusal surfaces, we did not perform a subgroup analysis. We assessed the quality of the evidence for this outcome as low, owing to serious issues of inconsistency (\( \chi^2 P = .03; I^2 = 80\% \)) and risk of bias (eTable 1, available online at the end of this article).
TABLE 2

Characteristics of the included studies.

<table>
<thead>
<tr>
<th>STUDY</th>
<th>COUNTRY</th>
<th>DESIGN</th>
<th>PARTICIPANTS</th>
<th>AGE RANGE, Y (MEAN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bojanini and Colleagues, 1976</td>
<td>Colombia</td>
<td>Split-mouth</td>
<td>Children with erupted, sound PM; setting was not clearly defined</td>
<td>6-8</td>
</tr>
<tr>
<td>Richardson and Colleagues, 1980</td>
<td>Canada</td>
<td>Split-mouth</td>
<td>Children with erupted, sound or carious PFM; setting was an elementary school clinic</td>
<td>7-8</td>
</tr>
<tr>
<td>Houpt and Shey, 1983</td>
<td>United States</td>
<td>Split-mouth</td>
<td>Children with erupted, sound PFM; setting was a dental van (mobile unit)</td>
<td>6-10</td>
</tr>
<tr>
<td>Mertz-Fairhurst and Colleagues, 1984</td>
<td>United States</td>
<td>Split-mouth</td>
<td>Children with erupted, sound PFM; setting was a dental school clinic</td>
<td>6-8</td>
</tr>
<tr>
<td>Erdogan and Alacam, 1987</td>
<td>Turkey</td>
<td>Split-mouth</td>
<td>Children with erupted, sound PFM; setting was not described</td>
<td>8-10</td>
</tr>
<tr>
<td>Arrow and Riordan, 1995</td>
<td>Australia</td>
<td>Split-mouth</td>
<td>Children with sound PFM; setting was a school clinic</td>
<td>7 (0.72)</td>
</tr>
<tr>
<td>Bravo and Colleagues, 1996</td>
<td>Spain</td>
<td>Parallel</td>
<td>Children with erupted, sound PFM; setting was a school clinic</td>
<td>6-8</td>
</tr>
<tr>
<td>Slieth and Colleagues, 2001</td>
<td>Germany</td>
<td>Split-mouth</td>
<td>Children with erupted, sound or carious PFM; setting was a private practice office</td>
<td>5-8</td>
</tr>
<tr>
<td>Pereira and Colleagues, 2003</td>
<td>Brazil</td>
<td>Parallel</td>
<td>Children with erupted, sound PFM; setting was a dental school clinic</td>
<td>6-8</td>
</tr>
<tr>
<td>Gungor and Colleagues, 2004</td>
<td>Turkey</td>
<td>Split-mouth</td>
<td>Children with erupted PFM; setting was a dental school clinic</td>
<td>7-10</td>
</tr>
<tr>
<td>Pardi and Colleagues, 2005</td>
<td>Brazil</td>
<td>Parallel</td>
<td>Children with erupted PFM; setting was a school clinic</td>
<td>7-8</td>
</tr>
<tr>
<td>Ganesh and Tandon, 2006</td>
<td>India</td>
<td>Split-mouth</td>
<td>Children with erupted, sound primary molars (Group 1) and erupted, sound permanent molars (Group 2)</td>
<td>Group 1: 3-5 Group 2: 6-7</td>
</tr>
<tr>
<td>Amin, 2008</td>
<td>Egypt</td>
<td>Parallel</td>
<td>Children with sound PFM; setting was a dental school clinic</td>
<td>7-10</td>
</tr>
<tr>
<td>Barja-Fidalgo and Colleagues, 2009</td>
<td>Brazil</td>
<td>Parallel</td>
<td>Children with erupted PFM; setting was a university dental clinic</td>
<td>6-8</td>
</tr>
<tr>
<td>Baseggio and Colleagues, 2004</td>
<td>Brazil</td>
<td>Split-mouth</td>
<td>Adolescents with erupted second PM; setting was a public health service center</td>
<td>12-16</td>
</tr>
<tr>
<td>Tagliaferro and Colleagues, 2011</td>
<td>Brazil</td>
<td>Parallel</td>
<td>Children with erupted, sound PFM; setting was a private practice</td>
<td>6-8</td>
</tr>
<tr>
<td>Antonson and Colleagues, 2012</td>
<td>United States</td>
<td>Split-mouth</td>
<td>Children with partially erupted PFM; setting not clearly defined, seems to be a university dental clinic</td>
<td>5-9</td>
</tr>
<tr>
<td>Chen and Colleagues, 2012 (2 reports)</td>
<td>China</td>
<td>Parallel</td>
<td>Children with erupted, carious PFM; setting was at 5 public schools</td>
<td>7-9.1</td>
</tr>
<tr>
<td>Dhar and Chen, 2012</td>
<td>India</td>
<td>Split-mouth</td>
<td>Children with erupted PFM; setting was a school clinic</td>
<td>6-10</td>
</tr>
<tr>
<td>Liu and Colleagues, 2012</td>
<td>China</td>
<td>Parallel</td>
<td>Children with erupted, sound or carious PFM; setting was a school clinic</td>
<td>Mean = 9.1</td>
</tr>
<tr>
<td>Chen and Liu, 2013</td>
<td>China</td>
<td>Split-mouth</td>
<td>Children with erupted, sound PFM; setting was a pediatric department of a university hospital</td>
<td>6.1-8.9</td>
</tr>
<tr>
<td>Guler and Yilmaz, 2013</td>
<td>Turkey</td>
<td>Split-mouth</td>
<td>Children with erupted PFM; setting was a dental school clinic</td>
<td>7-13</td>
</tr>
<tr>
<td>Haznedaroğlu and Colleagues, 2016</td>
<td>Turkey</td>
<td>Parallel</td>
<td>Children with fully erupted, sound PFMs; setting was a university pediatric clinic</td>
<td>7-10</td>
</tr>
</tbody>
</table>

* Information provided corresponds with the first follow-up period of the study.
† PM: Permanent molar.
‡ PFM: Permanent first molar.
§ GI: Glass ionomer.
¶ ppm: Parts per million.
The results of 1 study\(^2\) (242 participants) informed the comparison and outcome for the 7 or more years of follow-up category. In relative terms, participants who received sealants had a 71% reduction in the risk of developing new carious lesions (OR, 0.29; 95% CI, 0.17-0.49; \(P < .00001\)) compared with participants who received fluoride varnishes (eFigure 6, available online at the end of this article). Because the results of only 1 study informed this outcome, we did not perform a subgroup analysis. We assessed the quality of the evidence for this outcome as low, owing to very serious issues related to risk of bias (eTable 1, available online at the end of this article).

**TABLE 2 (CONTINUED)**

<table>
<thead>
<tr>
<th>FLUORIDE EXPOSURE</th>
<th>INTERVENTION</th>
<th>COMPARISON</th>
<th>SEALANT</th>
<th>COMPARISON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community water fluoridation</td>
<td>Resin-based sealant (Delton, Dentsply)</td>
<td>No sealant</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>Nonfluoridated community</td>
<td>Self-curing bisphenol A-glycidyl methacrylate sealant (3M)</td>
<td>No sealant</td>
<td>337</td>
<td>337</td>
</tr>
<tr>
<td>Community water fluoridation</td>
<td>Sealant (Delton, Dentsply)</td>
<td>Fluoride varnish (no further description)</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Community water fluoridation</td>
<td>Resin-based sealant (Delton, Dentsply)</td>
<td>No sealant</td>
<td>201</td>
<td>201</td>
</tr>
<tr>
<td>None</td>
<td>Resin-based sealant (Delton, Dentsply)</td>
<td>No sealant</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>Community water fluoridation</td>
<td>GI sealant (Ketac-fil, 3M)</td>
<td>Resin-based sealant (Delton, Dentsply)</td>
<td>412</td>
<td>412</td>
</tr>
<tr>
<td>Community water fluoridation</td>
<td>Resin-based sealant (Delton, Dentsply)</td>
<td>No sealant; fluoride varnish (Duraphat, Colgate-Palmolive)</td>
<td>238</td>
<td>272</td>
</tr>
<tr>
<td>Community water fluoridation</td>
<td>Sealant (Ketac bond, 3M)</td>
<td>No sealant; resin-modified GI sealant (Vitremer, 3M)</td>
<td>342</td>
<td>240</td>
</tr>
<tr>
<td>Nonfluoridated water; encouraged use of</td>
<td>Poly-acid modified resin (Dyact Seal, Dentsply)</td>
<td>Resin-based sealant (Delton FS+, Dentsply)</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Community water fluoridation</td>
<td>Resin-modified GI sealant (Vitremer, 3M)</td>
<td>Resin-based sealant (Revolution, Ken); poly-acid modified resin sealant (Dyact Flow, Dentsply)</td>
<td>97</td>
<td>182</td>
</tr>
<tr>
<td>None</td>
<td>GI sealant (Fuji VII, GC)</td>
<td>Resin-based sealant (Concise, 3M)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Fluoridated toothpaste</td>
<td>Resin-modified GI sealant (Fuji II LC, GC)</td>
<td>Resin-based sealant (Tetric Flow and Heliosil F, Ivoclar Vivadent)</td>
<td>24</td>
<td>54</td>
</tr>
<tr>
<td>Fluoridated toothpaste</td>
<td>GI sealant (Fuji IX, GC)</td>
<td>Resin-based sealant (Delton, Dentsply)</td>
<td>21</td>
<td>28</td>
</tr>
<tr>
<td>None</td>
<td>Resin-modified GI sealant (Vitremer, 3M)</td>
<td>Resin-based sealant (Flurosheild, Dentsply)</td>
<td>628</td>
<td>628</td>
</tr>
<tr>
<td>Community water fluoridation</td>
<td>Resin-modified GI sealant (Vitremer, 3M)</td>
<td>No sealant</td>
<td>91</td>
<td>86</td>
</tr>
<tr>
<td>None</td>
<td>GI sealant (Fuji Triage, GC)</td>
<td>Resin-based sealant (Delton FS+, Dentsply)</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>None</td>
<td>GI sealant (Ketac Molar Easymix, 3M)</td>
<td>Resin-based sealant (Clinpro, 3M)</td>
<td>1,282</td>
<td>452</td>
</tr>
<tr>
<td>None</td>
<td>GI sealant (Fuji VII, GC)</td>
<td>Resin-based sealant (Clinpro, 3M)</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>No community water fluoridation, but 90%</td>
<td>Resin-based sealant (Clinpro, 3M)</td>
<td>No sealant; fluoride varnish (5% sodium fluoride Duraphat, Colgate-Palmolive)</td>
<td>367</td>
<td>379</td>
</tr>
<tr>
<td>of participants reported using fluoridated toothpaste</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of 600 ppm fluoridated toothpaste.</td>
<td>GI sealant (Fuji VII, GC)</td>
<td>Resin-based sealant (Concise, 3M)</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>6,000 ppm foam applied at every recall visit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluoride varnish applied after sealant placement</td>
<td>GI sealant (Fuji VII, GC)</td>
<td>Resin-based sealant (Admira Seal, Voco)</td>
<td>68</td>
<td>66</td>
</tr>
<tr>
<td>&quot;Low fluoride&quot; in drinking water</td>
<td>GI sealant (Fuji Triage, GC)</td>
<td>Resin-based sealant (Ultraseal XT, Ultradent)</td>
<td>64</td>
<td>68</td>
</tr>
</tbody>
</table>
Lack of retention. The nature of the comparison did not allow us to obtain information to compare the use versus the nonuse of sealants.

**Comparison 3.**

**Glass ionomer sealants versus resin-based sealants.** Caries incidence. The results of 10 studies (28-30,32-36,38,39) (4,741 participants) informed the comparison and outcome for the 2- to 3-year follow-up category. In relative terms, participants who received GI sealants had a 29% reduction in the risk of developing new carious lesions compared with participants who received resin-based sealants (OR, 0.71; 95% CI, 0.32-1.57); however, this difference was not statistically significant ($P = .39$) (Figure 7, available online at the end of this article).

Owing to limitations in 1 study’s data presentation, we did not include that study (200 participants) in the meta-analysis. For that study, the investigators failed to find a clinically or statistically significant difference in caries incidence when they applied GI sealants and resin-based sealants in the occlusal surfaces of primary and permanent molars. In a subgroup analysis conducted to determine whether the treatment effect differed among studies with patients having non-cavitated occlusal carious lesions, sound occlusal surfaces, and a population with mixed clinical

<table>
<thead>
<tr>
<th>STUDIES</th>
<th>Random sequence generation (selection bias)</th>
<th>Allocation concealment (selection bias)</th>
<th>Allocation of participants and personnel (performance bias)</th>
<th>Masking of participants and personnel (assessment bias)</th>
<th>Masking of outcome data (detection bias)</th>
<th>Selective reporting (reporting bias)</th>
<th>Other bias</th>
<th>Risk of bias</th>
</tr>
</thead>
</table>

**Figure 2.** Risk of bias summary: review authors’ judgments about each risk of bias item for each included study. +: Low risk of bias. –: High risk of bias. ?: Unclear risk of bias.
features, we did not find statistically significant results (interaction test \( P = .19 \)). We assessed the quality of the evidence for this outcome as very low, owing to serious issues related to risk of bias, inconsistency (\( \chi^2 P > .00001; I^2 = 81\% \)), and imprecision (Table 4).

The results of 2 studies\(^{3,39} (145 \text{ participants})\) informed the comparison and outcome for the 4- to 7-year follow-up category. In relative terms, participants who received GI sealants had a 63% reduction in the risk of developing new carious lesions compared with participants who received resin-based sealants (OR, 0.37; 95% CI, 0.14-1.00; \( P = .05 \)) (eFigure 8, available online at the end of this article). Because we found only 2 studies to inform this outcome, we did not perform a subgroup analysis. We assessed the quality of the evidence for this outcome as very low, owing to serious issues related to risk of bias and very serious issues related to imprecision (Table 4).

We did not find any studies whose investigators had reported data on the incidence of caries for 7 or more years of follow-up for this comparison.

Lack of retention. The results of 10 studies\(^{28-30,32-36,38,39} (4,741 \text{ participants})\) informed the comparison and outcome for the 2- to 3-year follow-up category. In relative terms, participants who received GI sealants had 5 times greater chance (406% increased chance) of experiencing sealant retention loss compared with participants who received resin-based sealants (OR, 5.06; 95% CI, 1.81-14.13; \( P = .002 \)) (eFigure 9, available online at the end of this article). In a subgroup analysis conducted to determine whether the treatment effect differed among studies with patients who had noncavitated occlusal carious lesions, sound occlusal surfaces, and a population with mixed clinical features, we did not find statistically significant results (interaction test \( P = .29 \)). We assessed the quality of the evidence for this outcome as low, owing to serious issues related to risk of bias and inconsistency (\( \chi^2 P < .00001; I^2 = 96\% \)) (Table 4).

The results of 2 studies\(^{3,39} (145 \text{ participants})\) informed the comparison and outcome for the 4- to 7-year follow-up category. In relative terms, participants who received GI sealants had a 108% increase in the risk of experiencing a retention loss compared with the participants who received resin-based sealants (OR, 2.08; 95% CI, 0.15-27.95); however, this difference was not statistically significant (\( P = .38 \)) (eFigure 10, available online at the end of this article). Because only 2 studies informed this outcome, we did not perform a subgroup analysis. We assessed the quality of the evidence for this outcome as low, owing to serious issues related to risk of bias and imprecision (Table 4).

We did not find any studies whose investigators had reported data on the incidence of lack of sealant retention for 7 or more years of follow-up.

Comparison 4. Glass ionomer sealants versus resin-modified glass ionomer sealants. Caries incidence. The results of 1 study\(^{24} (344 \text{ participants})\) informed the comparison and outcome for the 2- to 3-year follow-up category. In relative terms, participants who received GI sealants had a 41% increased risk of developing new carious lesions compared with participants who received resin-modified GI sealants (OR, 1.43; 95% CI, 0.65-3.07) (eFigure 11, available online at the end of this article); however, this difference was not statistically significant (\( P = .38 \)). Because only 1 study informed this outcome, we did not perform a subgroup analysis. We assessed the quality of the evidence for this outcome as very low, owing to serious issues related to risk of bias and very serious issues related to imprecision (eTable 2, available online at the end of this article).

We did not find any studies whose investigators had reported data on caries incidence for the 4- to 7-year follow-up category and the more than 7 years of follow-up category.

Lack of retention. The results of 1 study\(^{24} (344 \text{ participants})\) informed this comparison and outcome for the 2- to 3-year follow-up category. In relative terms, participants who received GI sealants had 3 times greater chance (221% increased chance) to experience sealant retention loss compared with the participants who received resin-modified GI sealants (OR, 3.23; 95% CI, 1.87-5.61; \( P < .0001 \)) (eFigure 12, available online at the end of this article). Because only 1 study informed this outcome, we did not perform a subgroup analysis. We assessed the quality of the evidence as moderate, owing to serious issues related to risk of bias (eTable 2, available online at the end of this article).

We did not find any studies whose investigators had reported data on caries incidence for the 4- to 7-year follow-up category and the more than 7 years of follow-up category for this comparison and outcome.

Comparison 5. Resin-modified glass ionomer sealants versus polyacid-modified resin sealants. Caries incidence. The results of 1 study\(^{39} (186 \text{ participants})\) informed the comparison and outcome for the 2- to 3-year follow-up category. In relative terms, participants who received resin-modified GI sealants had a 56% reduction in the risk of developing new carious lesions compared with participants who received polyacid-modified resin sealants (OR, 0.44; 95% CI, 0.11-1.82); however, this difference was not statistically significant (\( P = .26 \)) (eFigure 13, available online at the end of this article). Because only 1 study informed this outcome, we did not perform a subgroup analysis. We assessed the quality of the evidence for this outcome as very low, owing to serious issues related to risk of bias and very serious issues related to imprecision (eTable 3, available online at the end of this article).

We did not find any studies whose investigators had reported data on caries incidence for the 4- to 7-year follow-up category and the more than 7 years of follow-up category for this comparison and outcome.

Lack of retention. The results of 1 study\(^{39} \text{ that included 186 participants informed the comparison and outcome for the 2- to 3-year follow-up category.} \) In relative terms, participants who received resin-modified
GI sealants had a 17% increased risk of experiencing sealant retention loss compared with the participants who received polyacid-modified resin sealants (OR, 1.17; 95% CI, 0.52-2.66); however, this difference was not statistically significant (P = .70) (eFigure 14, available online at the end of this article). Because only 1 study informed this outcome, we did not perform subgroup analysis. We assessed the quality of the evidence as very low, owing to serious issues related to risk of bias and very serious issues related to imprecision (eTable 3, available online at the end of this article).

We did not find any studies whose investigators had reported data for this comparison with regard to the outcome of lack of sealant retention for the 4- to 7-year follow-up category and the more than 7 years of follow-up category.

Comparison 6. Polyacid-modified resin sealants versus resin-based sealants. Caries incidence. The results of 2 studies37,38 (322 participants) informed the comparison and outcome for the 2- to 3-year follow-up category. In relative terms, participants who received polyacid-modified resin sealants had a 1% increased risk of developing new carious lesions compared with participants who received resin-based sealants (OR, 1.01; 95% CI, 0.48-2.14); however, this difference was not statistically significant (P = .97) (eFigure 15, available online at the end of this article). We were unable to find evidence of heterogeneity (χ², P = .39; I² = 0%). Because the investigators of the 2 studies included only participants with sound occlusal surfaces, we did not perform a subgroup analysis. We assessed the quality of the evidence for this outcome as very low, owing to serious issues related to risk of bias and very serious issues related to imprecision (eTable 4, available online at the end of this article).

We did not find any studies whose investigators had reported data on caries incidence for the 4- to 7-year follow-up category and the more than 7 years of follow-up category for this comparison and outcome.

Lack of retention. The results of 2 studies37,38 (322 participants) informed the comparison and outcome for

### TABLE 3

**Evidence profile: sealants compared with nonuse of sealants in pit-and-fissure occlusal surfaces in children and adolescents.***

<table>
<thead>
<tr>
<th>Quality Assessment</th>
<th>No. of Studies</th>
<th>Study Design</th>
<th>Risk of Bias</th>
<th>Inconsistency</th>
<th>Indirectness</th>
<th>Imprecision</th>
<th>Other Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caries incidence (follow-up: range 2-3 y)†</td>
<td>9</td>
<td>Randomized trials</td>
<td>Serious§</td>
<td>Not serious</td>
<td>Not serious</td>
<td>Not serious</td>
<td>None</td>
</tr>
<tr>
<td>Caries incidence (follow-up: range 4-7 y)¶</td>
<td>3</td>
<td>Randomized trials</td>
<td>Serious§</td>
<td>Not serious</td>
<td>Not serious</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Caries incidence (follow-up: range 7 y or more)‖</td>
<td>2</td>
<td>Randomized trials</td>
<td>Serious§</td>
<td>Not serious</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of retention (follow-up: range 2-3 y)</td>
<td>9</td>
<td>Randomized trials</td>
<td>Serious§</td>
<td>Not serious</td>
<td>Not serious</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

* Sources: Splieth and colleagues,1 Bojanini and colleagues,18 Bravo and colleagues,20 Erdogan and colleagues,21 Liu and colleagues,24 Mertz-Fairhurst and colleagues,25 Pereira and colleagues,26 Richardson and colleagues,27 Tagliarelli and colleagues.28
† A subgroup analysis conducted to determine whether there was a difference in the caries incidence depending on whether the sealant was placed in patients with noncavitated carious lesions or deep fissures and pits, no caries in the occlusal surface, and a mix of caries free and noncavitated carious lesions, showed no statistically significant differences (P = .58). Studies including a mixed population (recruiting both patients with noncavitated initial occlusal caries and caries-free occlusal surfaces) showed a 76% reduction in caries incidence after 2- to 3-y follow-up (odds ratio, 0.24; 95% confidence interval, 0.19-0.30).
‡ Most studies were classified as unclear for the “allocation concealment” and “masking” domains.
§ Most studies were classified as unclear for the “allocation concealment” and “masking” domains.
¶ 4 of 9 studies reported being conducted in water-fluoridated communities.
‖ 2 of 3 studies reported being conducted in water-fluoridated communities.
** Unexplained heterogeneity (P < .0001, I² = 77%).
†† 2 of 3 studies reported being conducted in water-fluoridated communities.
‡‡ 2 of 2 studies reported being conducted in water-fluoridated communities.
TABLE 3 (CONTINUED)

<table>
<thead>
<tr>
<th>PATIENTS (N)</th>
<th>EFFECT</th>
<th>QUALITY</th>
<th>IMPORTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sealants</td>
<td>Nonuse of Sealants†</td>
<td>Relative Odds Ratio (95% Confidence Interval)</td>
<td>Absolute (95% Confidence Interval)</td>
</tr>
<tr>
<td>194/1,799 (10.8%)</td>
<td>584/1,743 (33.5%)†</td>
<td>0.24 (0.19-0.30)</td>
<td>248 fewer per 1,000 (221-271 fewer)</td>
</tr>
<tr>
<td></td>
<td>30.0%</td>
<td></td>
<td>207 fewer per 1,000 (186-225 fewer)</td>
</tr>
<tr>
<td></td>
<td>70.0%</td>
<td></td>
<td>341 fewer per 1,000 (288-393 fewer)</td>
</tr>
<tr>
<td>74/368 (20.1%)</td>
<td>206/384 (53.6%)†</td>
<td>0.21 (0.10-0.44)</td>
<td>341 fewer per 1,000 (199-433 fewer)</td>
</tr>
<tr>
<td></td>
<td>30.0%</td>
<td></td>
<td>217 fewer per 1,000 (141-259 fewer)</td>
</tr>
<tr>
<td></td>
<td>70.0%</td>
<td></td>
<td>371 fewer per 1,000 (193-511 fewer)</td>
</tr>
<tr>
<td>62/215 (28.8%)</td>
<td>170/231 (73.6%)†</td>
<td>0.15 (0.08-0.27)</td>
<td>441 fewer per 1,000 (307-554 fewer)</td>
</tr>
<tr>
<td></td>
<td>30.0%</td>
<td></td>
<td>240 fewer per 1,000 (196-267 fewer)</td>
</tr>
<tr>
<td></td>
<td>70.0%</td>
<td></td>
<td>441 fewer per 1,000 (313-543 fewer)</td>
</tr>
</tbody>
</table>

Including all sealant material types and tooth preparation techniques, 55.6% of sealants were fully retained at 2 y, and 59.3% were fully or partially retained at 2 y; at 3 y, 56.4% of all sealants were fully retained, and 58.8% were fully or partially retained after 3.6 y.

the 2- to 3-year follow-up category. In relative terms, participants who received polyacid-modified resin sealants had a 23% reduction in the risk of experiencing sealant retention loss compared with participants who received resin-based sealants (OR, 0.87; 95% CI, 0.12-6.21); however, this difference was not statistically significant (P = .89) (eFigure 16, available online at the end of this article). Because the investigators of the 2 studies included only participants with sound occlusal surfaces, we did not perform a subgroup analysis. We assessed the quality of the evidence for this outcome as very low, owing to serious issues related to risk of bias, inconsistency (χ² P = .02; I² = 81%), and imprecision (eTable 4, available online at the end of this article).

We did not find any studies whose investigators had reported data for this comparison with regard to the outcome of lack of sealant retention for the 4- to 7-year follow-up category and the more than 7 years of follow-up category.

Safety of sealants. The investigators of 2 studies22,42 sought to measure adverse events associated with the use of sealants. The investigators of these RCTs were unable to identify any adverse events among the participants.

DISCUSSION

Summary of the results. The results of this systematic review suggest that children and adolescents who receive sealants in sound occlusal surfaces or noncavitated pit-and-fissure carious lesions in their primary or permanent molars (compared with a control without sealants) experienced a 76% reduction in the risk of developing new carious lesions after 2 years of follow-up. Even after 7 or more years of follow-up, children and adolescents with sealants had a caries incidence of 29%, whereas those without sealants had a caries incidence of 74%. We assessed the quality of the evidence as being moderate, owing to serious issues related to the risk of bias. Furthermore, low-quality evidence (owing to serious issues related to the risk of bias and inconsistency) suggested that sealants applied to the pits and fissures of primary and permanent molars may be more beneficial than the application of fluoride varnishes after 7 or more years of follow-up (that is, 290 fewer carious lesions over 1,000; ranging from 176 fewer carious lesions over 1,000, to 381 fewer carious lesions over 1,000). We did not identify any studies whose investigators provided information about the effect of sealants in adults.

The head-to-head analysis of the effect of sealant materials on caries incidence and retention loss did not provide enough evidence for us to reliably offer a description of the relative merits of each sealant material. When making clinical decisions, we suggest that clinicians take into account the likelihood that their patients will experience a lack of retention inherent to the sealant material as well as their ability to isolate and maintain a dry field during placement.

Quality of the evidence. We found moderate-quality evidence for the outcome of caries incidence in the comparison of sealants versus the control without sealants. When we tried to make more specific comparisons, we found that the quality of the evidence decreased to
low or very low for most of the outcomes measured related to the head-to-head sealant comparisons. The main issues we identified among the comparisons related to risk of bias, inconsistency, and imprecision.

Comparison with previous reviews. The authors of 1 Cochrane review published in 2013 summarized the evidence on the effect of sealants versus fluoride varnishes in children aged 5 to 10 years. Again, although we differed in the inclusion and exclusion of some studies, their conclusions in relation to the effect of sealants and the assessment of the quality of the evidence coincide with ours.43 The authors of yet another systematic review published in 2016 aimed to determine the effectiveness of high-viscosity GI sealants compared with resin-based sealants. Finally, the authors of a systematic review published in 2016 on the use of adhesive systems under fissure sealants concluded that bonding agents could increase the retention of sealants. These authors did not include dental caries as an outcome, and they further concluded that there was insufficient evidence to make comparisons among different generations of adhesive systems.45
Strength and limitations of this review. The strength of this systematic review lies in the rigor of its methodology, which follows the recommendations in the Cochrane Handbook for Systematic Reviews of Interventions. For example, we conducted screening and data extraction in duplicate, pooled the results of split-mouth and parallel design trials, adjusting for the dependence of the observations, and we assessed the quality of the evidence using the GRADE approach. Limitations included our inability to contact primary authors of the studies to clarify issues related to risk of bias or specific study features owing to the fact that most of the included trials were published more than 20 years ago, and the inability to assess publication bias by means of using a funnel plot owing to the limited number of included studies per outcome.

CONCLUSIONS
In summary, we found moderate-quality evidence to suggest that the use of sealants when compared with control groups that did not have sealants reduces the incidence of carious lesions in the occlusal surfaces of permanent molars by approximately 80% in children and adolescents. When comparing this finding with the results associated with fluoride varnishes, we found that sealants still were associated with a reduction in the incidence of carious lesions in the occlusal surfaces of permanent molars of approximately 70%, which, in this case, was supported by low-quality evidence. Also, we found that none of the investigators of the studies reported adverse outcomes. Finally, although in our analysis we failed to find a hierarchy of effectiveness, which prevented us from making strong statements about the relative merits of each sealant material, we did find that sealants compared with no sealants or fluoride varnishes prove superior in preventing carious lesions and arresting the progression of noncavitated carious lesions.

SUPPLEMENTAL DATA
Supplemental data related to this article can be found at http://dx.doi.org/10.1016/j.jada.2016.06.003.

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<table>
<thead>
<tr>
<th>PATIENTS (N)</th>
<th>EFFECT</th>
<th>QUALITY</th>
<th>IMPORTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass Ionomer Sealants</td>
<td>Resin-Based Sealants</td>
<td>Relative Odds Ratio (95% Confidence Interval)</td>
<td>Absolute (95% Confidence Interval)</td>
</tr>
<tr>
<td>179/2,727 (6.6%)</td>
<td>141/2,014 (7.0%)</td>
<td>0.71 (0.32-1.57)</td>
<td>19 fewer per 1,000 (0-46 fewer)</td>
</tr>
<tr>
<td>6/61 (9.8%)</td>
<td>19/84 (22.6%)</td>
<td>0.37 (0.14-1.00)</td>
<td>154 fewer per 1,000 (0-228 fewer)</td>
</tr>
<tr>
<td>1,875/2,727 (68.8%)</td>
<td>596/2,014 (29.6%)</td>
<td>5.06 (1.81-14.13)</td>
<td>384 more per 1,000 (136-560 more)</td>
</tr>
<tr>
<td>46/61 (75.4%)</td>
<td>50/84 (59.5%)</td>
<td>2.08 (0.15-27.95)</td>
<td>158 more per 1,000 (0-243 fewer)</td>
</tr>
</tbody>
</table>
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Appendix.
SEARCH STRATEGIES AND ELECTRONIC DATABASES CONSULTED.

SEARCHES CONDUCTED IN NOVEMBER 2013.

Embase. The following search strategy was linked to the Cochrane Highly Sensitive Search Strategy for identifying randomized trials:
1. 'pit and fissure sealants'/exp
2. fissure* NEAR/6 seal*
3. dental NEAR/6 seal*
4. resin* NEAR/6 seal*
5. compomer* NEAR/6 seal*
6. composite* NEAR/6 seal*
7. exp Glass Ionomer Cements/
8. exp Resins, Synthetic/
9. glass NEXT/1 ionomer* OR glassionomer* 10. 7 or 8 or 9 11. seal* 12. 10 and 11 13. 1 or 2 or 3 or 4 or 5 or 6 or 12 14. . (tetric OR vitremer OR fluoroshield OR delton OR kerr OR lispro OR dyract OR revolution OR oralis OR ketac OR concise) .tw.

Cochrane Central Register of Controlled Trials (CENTRAL).
1. fissure*
2. MeSH descriptor: [Composite Resins] explode all trees
3. MeSH descriptor: [Pit and Fissure Sealants] explode all trees
4. MeSH descriptor: [Glass Ionomer Cements] explode all trees
5. dental
6. resin*
7. compomer*
8. sealant*
9. composite*
10. "glass ionomer"
11. glassionomer*
12. (#2 or #4 or #5 or #6 or #7 or #9 or #10 or #11 or #1) and #8
13. #3 or #12

ClinicalTrials.gov. Dental and sealant
LILACS.
- (sealantes OR sellantes OR sealants) OR (pit and fissure sealants) AND ((Pt RANDOMIZED CONTROLLED TRIAL OR Pt CONTROLLED CLINICAL TRIAL OR Mh RANDOMIZED CONTROLLED TRIALS OR Mh RANDOM ALLOCATION OR Mh DOUBLE-BLIND METHOD OR Mh SINGLE-BLINDMETHOD OR Pt MULTICENTER STUDY) OR ((tw ensaio or tw ensayo or tw trial) and (tw azar or tw acaso or tw placebo or tw control$ or tw aleat$ or tw random$ or (tw duplo and tw cego) or (tw doble and tw ciego) or (tw double and tw blind)) and tw clinic$)) AND NOT ((CT ANIMALS OR MH ANIMALS OR CT RABBITS OR CT MICE OR MH RATS OR MH PRIMATES OR MH DOGS OR MH RABBITS OR MH SWINE) AND NOT (CT HUMAN AND CT ANIMALS))
- tetric or vitremer or fluoroshield or delton or kerr or lispro or dyract or revolution or oralis or ketac or concise [Words] and ((Pt RANDOMIZED CONTROLLED TRIAL OR Pt CONTROLLED CLINICAL TRIAL OR Mh RANDOMIZED CONTROLLED TRIALS OR Mh RANDOM ALLOCATION OR Mh DOUBLE-BLIND METHOD OR Mh SINGLE-BLINDMETHOD OR Pt MULTICENTER STUDY) OR ((tw ensaio or tw ensayo or tw trial) and (tw azar or tw acaso or tw placebo or tw control$ or tw aleat$ or tw random$ or (tw duplo and tw cego) or (tw doble and tw ciego) or (tw double and tw blind)) and tw clinic$)) AND NOT ((CT ANIMALS OR MH ANIMALS OR CT RABBITS OR CT MICE OR MH RATS OR MH PRIMATES OR MH DOGS OR MH RABBITS OR MH SWINE) AND NOT (CT HUMAN AND CT ANIMALS))
- Composta OR composite [Words] AND selante OR sellante [Words] and ((Pt RANDOMIZED CONTROLLED TRIAL OR Pt CONTROLLED CLINICAL TRIAL OR Mh RANDOMIZED CONTROLLED TRIALS OR Mh RANDOM ALLOCATION OR Mh DOUBLE-BLIND METHOD OR Mh SINGLE-BLINDMETHOD OR Pt MULTICENTER STUDY) OR ((tw ensaio or tw ensayo or tw trial) and (tw azar or tw acaso or tw placebo or tw control$ or tw aleat$ or tw random$ or (tw duplo and tw cego) or (tw doble and tw ciego) or (tw double and tw blind)) and tw clinic$)) AND NOT ((CT ANIMALS OR MH ANIMALS OR CT RABBITS OR CT MICE OR MH RATS OR MH PRIMATES OR MH DOGS OR MH RABBITS OR MH SWINE) AND NOT (CT HUMAN AND CT ANIMALS)) [Words]
- resin OR resina [Words] and selante OR sellante [Words] and ((Pt RANDOMIZED CONTROLLED TRIAL OR Pt CONTROLLED CLINICAL TRIAL OR Mh RANDOMIZED CONTROLLED TRIALS OR Mh RANDOM ALLOCATION OR Mh DOUBLE-BLIND METHOD OR Mh SINGLE-BLINDMETHOD OR Pt MULTICENTER STUDY) OR ((tw ensaio or tw ensayo OR PICO: Pit and Fissure Sealants AND Resins, Synthetic AND Glass Ionomer Cements AND Dental and Sealant AND LILACS AND ClinicalTrials.gov AND Dental and Sealant AND PICO: Pit and Fissure Sealants AND Resins, Synthetic AND Glass Ionomer Cements AND Dental and Sealant AND LILACS AND ClinicalTrials.gov AND Dental and Sealant OR PICO: Pit and Fissure Sealants AND Resins, Synthetic AND Glass Ionomer Cements AND Dental and Sealant AND LILACS AND ClinicalTrials.gov AND Dental and Sealant OR PICO: Pit and Fissure Sealants AND Resins, Synthetic AND Glass Ionomer Cements AND Dental and Sealant AND LILACS AND ClinicalTrials.gov AND Dental and Sealant)}
or tw trial) and (tw azar or tw acaso or tw placebo or tw control$ or tw aleat$ or tw random$ or (tw duplo and tw cego) or (tw doble and tw ciego) or (tw double and tw blind)) and tw clinic$)) AND NOT ((CT ANIMALS OR MH ANIMALS OR CT RABBITS OR CT MICE OR MH RATS OR MH PRIMATES OR MH DOGS OR MH RABBITS OR MH SWINE) AND NOT (CT HUMAN AND CT ANIMALS)) [Words] [Words]

- ionômero [Words] and selante OR sellante [Words] and ((Pt RANDOMIZED CONTROLLED TRIAL OR Pt CONTROLLED CLINICAL TRIAL OR Mh RANDOMIZED CONTROLLED TRIALS OR Mh RANDOM ALLOCATION OR Mh DOUBLE-BLIND METHOD OR Mh SINGLE-BLIND METHOD OR Pt MULTICENTER STUDY) OR ((tw ensaio or tw ensayo or tw trial) and (tw azar or tw acaso or tw placebo or tw control$ or tw aleat$ or tw random$ or (tw duplo and tw cego) or (tw doble and tw ciego) or (tw double and tw blind)) and tw clinic$)) AND NOT ((CT ANIMALS OR MH ANIMALS OR CT RABBITS OR CT MICE OR MH RATS OR MH PRIMATES OR MH DOGS OR MH RABBITS OR MH SWINE) AND NOT (CT HUMAN AND CT ANIMALS)) [Words]

- Bisphenol A-Glycidyl Methacrylate [Words] and selante OR sellante [Words] and ((Pt RANDOMIZED CONTROLLED TRIAL OR Pt CONTROLLED CLINICAL TRIAL OR Mh RANDOMIZED CONTROLLED TRIALS OR Mh RANDOM ALLOCATION OR Mh DOUBLE-BLIND METHOD OR Mh SINGLE-BLIND METHOD OR Pt MULTICENTER STUDY) OR ((tw ensaio or tw ensayo or tw trial) and (tw azar or tw acaso or tw placebo or tw control$ or tw aleat$ or tw random$ or (tw duplo and tw cego) or (tw doble and tw ciego) or (tw double and tw blind)) and tw clinic$)) AND NOT ((CT ANIMALS OR MH ANIMALS OR CT RABBITS OR CT MICE OR MH RATS OR MH PRIMATES OR MH DOGS OR MH RABBITS OR MH SWINE) AND NOT (CT HUMAN AND CT ANIMALS)) [Words]
Evidence-based clinical practice guideline for the use of pit-and-fissure sealants

A report of the American Dental Association and the American Academy of Pediatric Dentistry

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ABSTRACT

Background. This article presents evidence-based clinical recommendations for the use of pit-and-fissure sealants on the occlusal surfaces of primary and permanent molars in children and adolescents. A guideline panel convened by the American Dental Association (ADA) Council on Scientific Affairs and the American Academy of Pediatric Dentistry conducted a systematic review and formulated recommendations to address clinical questions in relation to the efficacy, retention, and potential side effects of sealants to prevent dental caries; their efficacy compared with fluoride varnishes; and a head-to-head comparison of the different types of sealant material used to prevent caries on pits and fissures of occlusal surfaces.

Types of Studies Reviewed. This is an update of the ADA 2008 recommendations on the use of pit-and-fissure sealants on the occlusal surfaces of primary and permanent molars. The authors conducted a systematic search in MEDLINE, Embase, Cochrane Central Register of Controlled Trials, and other sources to identify randomized controlled trials reporting on the effect of sealants (available on the US market) when applied to the occlusal surfaces of primary and permanent molars. The authors used the Grading of Recommendations Assessment, Development, and Evaluation approach to assess the quality of the evidence and to move from the evidence to the decisions.

Results. The guideline panel formulated 3 main recommendations. They concluded that sealants are effective in preventing and arresting pit-and-fissure occlusal carious lesions of primary and permanent molars in children and adolescents compared with the nonuse of sealants or use of fluoride varnishes. They also concluded that sealants could minimize the progression of noncavitated occlusal carious lesions (also referred to as initial lesions) that receive a sealant. Finally, based on the available limited evidence, the panel was unable to provide specific recommendations on the relative merits of 1 type of sealant material over the others.

Conclusions and Practical Implications. These recommendations are designed to inform practitioners during the clinical decision-making process in relation to the prevention of occlusal carious lesions in children and adolescents. Clinicians are encouraged to discuss the information in this guideline with patients or the parents of patients. The authors recommend that clinicians reorient their efforts toward increasing the use of sealants on the occlusal surfaces of primary and permanent molars in children and adolescents.

Key Words. Pit-and-fissure sealants; clinical recommendations; guideline; occlusal caries; caries prevention; caries arresting.

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to emerge for managing pit-and-fissure caries, further complicating the clinician’s decision making. Accordingly, continuous critical review of the available evidence is necessary to update evidence-based recommendations and assist health care providers in clinical decision making.6–7

The American Dental Association (ADA) Council on Scientific Affairs convened an expert panel to develop the previous evidence-based clinical recommendations for the use of sealants, published in 2008.1 In an effort to update the 2008 recommendations, the ADA Council on Scientific Affairs and the ADA Center for Evidence-Based Dentistry, in collaboration with the American Academy of Pediatric Dentistry (AAPD), convened a new working group including clinical experts, stakeholders, and methodologists to develop a systematic review8 and accompanying evidence-based clinical practice recommendations for publication in 2016.

Our goal for this 2016 clinical practice guideline was to provide clinicians with updated evidence-based recommendations regarding when and how the placement of pit-and-fissure sealants is most likely to be effective in preventing carious lesions on the occlusal surfaces of primary and permanent teeth in children and adolescents. The target audience for this guideline includes general and pediatric dental practitioners and their support teams, public health dentists, dental hygienists, pediatricians, primary-care physicians, and community dental health coordinators; policy makers may also benefit from this guideline to inform clinical decision making, programmatic decisions, and public health policy.

DEFINITION OF DENTAL CARIES

Dental caries is a disease caused by an ecological shift in the composition and activity of the bacterial biofilm when exposed over time to fermentable carbohydrates, leading to a break in the balance between demineralization and remineralization.4 Carious lesions are preventable by averting onset, and manageable by implementing interventions, which may halt progression from early stage of the disease to cavitation, characterized by enamel demineralization, to frank cavitation.1 In 2015, the ADA published the Caries Classification System, which defines a noncavitated or initial lesion as “initial caries lesion development, before cavitation occurs. Noncavitated lesions are characterized by a change in color, glossiness or surface structure as a result of demineralization before there is macroscopic breakdown in surface tooth structure.”3

EPIDEMIOLOGY

National Health and Nutrition Examination Survey (NHANES) 2011-20122 data show that 21% of children aged 6 to 11 years and 58% of adolescents aged 12 to 19 years had experienced carious lesions (untreated and treated [restored]) in their permanent teeth.

The NHANES report also found the prevalence of carious lesions in permanent teeth increased with age and differed among sociodemographic groups. Children in the 9- to 11-year range had higher carious lesion prevalence (29%) compared with children in the 6- to 8-year range (14%). Similarly, children in the 16- to 19-year age range had higher carious lesion prevalence (67%) compared with children in the 12- to 15-year range (50%). In addition, dental caries incidence for both 6- to 11-year and 12- to 19-year age groups was highest among Hispanic children compared with non-Hispanic black children, non-Hispanic white children, and Asian children. The surgeon general’s report on oral health similarly indicated that Hispanic and non-Hispanic black children are at the highest risk of developing dental caries.5

Overall, NHANES 2011-2012 indicates a higher prevalence of untreated carious lesions in the 12- to 19-year age group (15%) compared with the 6- to 11-year age group (6%).5

Although there has been a decline in prevalence of caries in adolescents and children in particular, the decrease in occlusal surface caries has not kept pace with the decrease in the smooth surface caries.2 Although this overall decline has been attributed to preventive interventions such as water fluoridation, fluoride toothpaste, fluoride varnishes, and sealants, topical fluoride applications—such as fluoride varnishes—may have a greater effect reducing carious lesions on smooth surfaces compared with caries in pits and fissures.7–8,10

NHANES 2011-2012 data show that 41% of children aged 9 to 11 years and 43% of adolescents aged 12 to 19 years had at least 1 dental sealant. Non-Hispanic black children had the lowest dental sealant prevalence in both age groups compared with Hispanic, non-Hispanic white, and Asian children.5 Therefore, underutilization of sealants is of key concern.

POTENTIAL ROLE OF PIT-AND-FISSURE SEALANTS IN PRIMARY AND SECONDARY PREVENTION

From a primary prevention perspective, anatomic grooves or pits and fissures on occlusal surfaces of permanent molars trap food debris and promote the presence of bacterial biofilm, thereby increasing the risk of developing carious lesions. Effectively penetrating and sealing these surfaces with a dental material—for example, pit-and-fissure sealants—can prevent lesions and is part of a comprehensive caries management approach.11

From a secondary prevention perspective, there is evidence that sealants also can inhibit the progression

of noncavitated carious lesions. The use of sealants to arrest or inhibit the progression of carious lesions is important to the clinician when determining the appropriate intervention for noncavitated carious lesions.

SEALANT MATERIALS AND PLACEMENT TECHNIQUES
For the purposes of this report, there are 4 sealant materials under a classification proposed by Anusavice and colleagues: resin-based sealants, glass ionomer (GI) cements, GI sealants, polyacid-modified resin sealants, and resin-modified GI sealants. They defined the materials as follows.
- Resin-based sealants are urethane dimethacrylate, “UDMA,” or bisphenol A-glycidyl methacrylate (also known as “bis-GMA”) monomers polymerized by either a chemical activator and initiator or light of a specific wavelength and intensity. Resin-based sealants come as unfilled, colorless, or tinted transparent materials or as filled, opaque, tooth-colored, or white materials.
- GI sealants are cements that were developed and are used for their fluoride-release properties, stemming from the acid-base reaction between a fluoroaluminosilicate glass powder and an aqueous-based polyacrylic acid solution.
- Polyacid-modified resin sealants, also referred to as compomers, combine resin-based material found in traditional resin-based sealants with the fluoride-releasing and adhesive properties of GI sealants.
- Resin-modified GI sealants are essentially GI sealants with resin components. This type of sealant has similar fluoride-release properties as GI, but it has a longer working time and less water sensitivity than do traditional GI sealants.

Placement techniques for pit-and-fissure sealants vary based on sealant type and the manufacturer or brand. Manufacturers’ instructions usually detail cleaning and isolation of the occlusal surface and encourage a dry environment during sealant placement and curing. Acid etching of occlusal surfaces is required before resin-based sealant placement. Other techniques mentioned in the studies included in the 2008 report are the use of bonding agents or adhesives, as well as mechanical preparations such as air abrasion or enamoplasty.

CLINICAL QUESTIONS REGARDING PIT-AND-FISSURE SEALANTS
To assist clinicians in the use of pit-and-fissure sealants in occlusal surfaces of primary and permanent molars, the guideline panel developed the following clinical questions:
- Should dental sealants, when compared with nonuse of sealants, be used in pits and fissures of occlusal surfaces of primary and permanent molars on teeth deemed to have clinically sound occlusal surfaces or noncavitated carious lesions?
- Should dental sealants, when compared with fluoride varnishes, be used in pits and fissures of occlusal surfaces of primary and permanent molars on teeth deemed to have clinically sound occlusal surfaces or noncavitated carious lesions?
- Which type of sealant material should be used in pits and fissures of occlusal surfaces of primary and permanent molars on teeth deemed to have clinically sound occlusal surfaces or noncavitated carious lesions?
- Are there any adverse events associated with the use of pit-and-fissure sealants?

METHODS
This clinical practice guideline follows the recommendations of the Appraisal of Guidelines Research & Evaluation (known as “AGREE”) reporting checklist.

Guideline panel configuration. The ADA Council on Scientific Affairs and the AAPD convened a guideline panel in 2014. The members of this panel were recognized for their level of clinical and research expertise and represented the different perspectives required for clinical decision making (general dentists, pediatric dentists, dental hygienists, and health policy makers). Methodologists from the ADA Center for Evidence-Based Dentistry oversaw the guideline development process.

Scope and purpose. The purpose of these recommendations is to provide guidance on sealant use for the prevention of pit-and-fissure occlusal carious lesions in both primary and permanent molars. The target audience for this guideline are front-line clinicians in general practice, pediatric dentists, dental hygienists, dental therapists, community dental health coordinators, dental health policy makers and program planners, and other members of the dental team. Although the evidence came from various settings, we excluded those sealant materials not commercially available at the time of this review.

Retrieving the evidence. Our systematic review methodology for developing this guideline is presented elsewhere. Briefly, we conducted systematic searches in MEDLINE, Embase, Cochrane Central Register of Controlled Trials, and other sources to identify randomized controlled trials reporting on the effect of sealants (available on the US market) when applied to the occlusal surfaces of primary and permanent molars. After pairs of independent reviewers conducted title and abstract retrieval, full-text screening, and data extraction, we organized the data retrieved using Grading of Recommendations Assessment, Development, and Evaluation (GRADE) evidence profiles. In addition, we requested the guideline panel to rank the relative importance of outcomes for decision making in 3 categories (critical, important, and not important) following guidance from the GRADE working group.

Assessing the certainty in the evidence. We assessed the certainty in the evidence (also known as the quality of the evidence) using the approach described by the GRADE working group. The certainty in the evidence
TABLE 1

| Definition of quality of the evidence and strength of recommendations. |
|-----------------------------|-----------------------------|
| **EVIDENCE QUALITY AND CERTAINTY DEFINITIONS** |
| Category | Definition |
| High | We are very confident that the true effect lies close to that of the estimate of the effect |
| Moderate | We are moderately confident in the effect estimate; the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different |
| Low | Our confidence in the effect estimate is limited; the true effect may be substantially different from the estimate of the effect |
| Very Low | We have very little confidence in the effect estimate; the true effect is likely to be substantially different from the estimate of effect |

**DEFINITION OF STRONG AND CONDITIONAL RECOMMENDATIONS AND IMPLICATIONS FOR STAKEHOLDERS**

<table>
<thead>
<tr>
<th>Implications</th>
<th>Strong Recommendations</th>
<th>Conditional Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>For Patients</td>
<td>Most people in this situation would want the recommended course of action, and only a small proportion would not; formal decision aids are not likely to be needed to help people make decisions consistent with their values and preferences</td>
<td>Most people in this situation would want the suggested course of action, but many would not</td>
</tr>
<tr>
<td>For Clinicians</td>
<td>Most people should receive the intervention; adherence to this recommendation according to the guideline could be used as a quality criterion or performance indicator</td>
<td>Recognize that different choices will be appropriate for individual patients and that you must help each patient arrive at a management decision consistent with his or her values and preferences; decision aids may be useful in helping people to make decisions consistent with their values and preferences</td>
</tr>
<tr>
<td>For Policy Makers</td>
<td>The recommendation can be adapted as policy in most situations</td>
<td>Policy making will require substantial debate and involvement of various stakeholders</td>
</tr>
</tbody>
</table>

* Reproduced with permission of the publisher from Balshem and colleagues.13
† Sources: Andrews and colleagues.14,15

in the context of clinical practice guidelines reflects the extent to which the guideline panel felt confident about the estimates of effect used for the decision-making process. The GRADE approach classifies the certainty in the evidence as high, moderate, low, or very low (Table 13-15), depending on whether the body of evidence at an outcome level includes serious or very serious issues as follows:

- Risk of bias: When the studies that are part of the body of evidence are affected by serious or very serious limitations in study design, the confidence in the estimates of effect is reduced owing to the increased risk of bias.16
- Imprecision: When the confidence intervals (CIs) of the data used for the treatment effects are too wide to make decisions, the confidence in the estimates of effect is reduced owing to issues of imprecision. Typically, imprecision occurs when the CIs suggest both a large benefit on one side and a large harm on the other side.17
- Inconsistency: When the studies comprising the body of evidence provide inconsistent results, the confidence in the estimates of effect is reduced owing to the unexplained heterogeneity among them.18
- Indirectness: When the population, interventions, comparator, or outcomes reported in the studies comprising the body of evidence do not directly match the ones the panel requires to make an informed decision, the confidence in the estimates of effect is reduced owing to this mismatching issue.19
- Publication bias: When there is suspicion that not all studies conducted to inform a particular treatment effect are available or they were selectively published or unpublished, the confidence in the estimates of effect is reduced owing to the suspicion of reporting bias.20

**Moving from the evidence to the decisions.** To assist the guideline panel with formulating recommendations and grading the strength of the recommendations, we used the evidence-to-decision framework, including the following domains: balance between the desirable and undesirable consequences (net effect), certainty in the evidence (also called quality of the evidence), patients’ values and preferences, and resource use.14,15 According to the GRADE approach, the strength of a recommendation is either strong or conditional, in which each grade of the strength has different implications for patients, clinicians, and policy makers (Table 1).

The guideline recommendations in this article were formulated collectively via 3 videoconferences with members of the guideline panel and methodologists from the ADA Center for Evidence-Based Dentistry and the AAPD held in January 2016. Deliberation and consensus were the main methods to develop these recommendations using the “evidence-to-decision” framework.14,15 When consensus was elusive, the panel was presented with the positions under assessment, and it voted accordingly.21 We identified potential conflicts of interest and managed them according to the recommendations from the World Health Organization and other guideline development agencies.22

**Guideline updating process.** The ADA Center for Evidence-Based Dentistry and the AAPD monitor the literature to identify new studies that may be included in the recommendations. These recommendations will be updated 5 years from the date of submission for
TABLE 2

Summary of clinical recommendations on the use of pit-and-fissure sealants in the occlusal surfaces of primary and permanent molars in children and adolescents.

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>RECOMMENDATION</th>
<th>QUALITY OF THE EVIDENCE</th>
<th>STRENGTH OF RECOMMENDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Should dental sealants, when compared with nonuse of sealants, be used in pits and fissures of occlusal surfaces of primary and permanent molars on teeth deemed to have clinically sound occlusal surfaces or noncavitated carious lesions?</td>
<td>The sealant guideline panel recommends the use of sealants compared with nonuse in permanent molars with both sound occlusal surfaces and noncavitated occlusal carious lesions in children and adolescents†</td>
<td>Moderate</td>
<td>Strong</td>
</tr>
<tr>
<td>Should dental sealants, when compared with fluoride varnishes, be used in pits and fissures of occlusal surfaces of primary and permanent molars on teeth deemed to have clinically sound occlusal surfaces or noncavitated carious lesions?</td>
<td>The sealant guideline panel suggests the use of sealants compared with fluoride varnishes in permanent molars with both sound occlusal surfaces and noncavitated occlusal carious lesions in children and adolescents*</td>
<td>Low</td>
<td>Conditional</td>
</tr>
<tr>
<td>Which type of sealant material should be used in pits and fissures of occlusal surfaces of primary and permanent molars on teeth deemed to have clinically sound occlusal surfaces or noncavitated carious lesions?</td>
<td>The panel was unable to determine superiority of 1 type of sealant over another owing to the very low quality of evidence for comparative studies; the panel recommends that any of the materials evaluated (for example, resin-based sealants, resin-modified glass ionomer sealants, glass ionomer cements, and polyacryl-modified resin sealants, in no particular order) can be used for application in permanent molars with both sound occlusal surfaces and noncavitated occlusal carious lesions in children and adolescents (conditional recommendation, very low-quality evidence)‡</td>
<td>Very low</td>
<td>Conditional</td>
</tr>
</tbody>
</table>

* These recommendations are applicable to both sound surfaces and noncavitated carious lesions: "Noncavitated lesions are characterized by a change in color, glossiness, or surface structure as a result of demineralization before there is macroscopic breakdown in surface tooth structure. These lesions represent areas with net mineral loss due to an imbalance between demineralization and remineralization. Reestablishing a balance between demineralization and remineralization may stop the caries disease process while leaving a visible clinical sign of past disease."† The guideline panel suggests that clinicians should take into account the likelihood of experiencing lack of retention when choosing the type of sealant material most appropriate for a specific patient and clinical scenario. For example, in situations in which dry isolation is difficult, such as a tooth that is not fully erupted and has soft tissue impinging on the area to be sealed, then a material that is more hydrophilic (for example, glass ionomer) would be preferable to a hydrophobic resin-based sealant. On the other hand, if the tooth can be isolated to ensure a dry site and long-term retention is desired, then a resin-based sealant may be preferable.

**RECOMMENDATIONS**

How to use these recommendations. The recommendations in this clinical practice guideline aim to assist patients, clinicians, and other stakeholders when making health care decisions. Although this clinical practice guideline covers the typical patient that the target audience treats on a daily basis, there may be specific situations in which clinicians may want to deviate from the recommendations listed below. Clinical expertise plays a key role in determining which patients fit into the scope of this guideline and how these recommendations align with the values, preferences, and the context of an individual patient.53

When the panel grades a recommendation as strong, this means that in most situations clinicians may want to follow the course of action suggested by the panel and only in a selected few circumstances may they need to deviate from it. Strong recommendations are usually associated with benefits or harms clearly outweighing one over the other, based on high- to moderate-quality evidence (certainty in the evidence), overall homogeneous values and preferences among patients, and inexpensive or easy-to-implement interventions.14,35 Conditional recommendations, on the other hand, indicate that clinicians may want to follow the course of action suggested by the panel; however, the panel also recognizes that different choices would be appropriate for individual patients. This type of recommendation is usually associated with a close balance between benefits and harms, low- to very low-quality evidence, important variability in patients' values and preferences, and substantial costs or challenges when trying to implement the intervention (Table 1).34,35 When facing a conditional recommendation, clinicians should pay special attention to the reasons that justify such judgment from the guideline panel. This information can be found in the remarks section presented with each recommendation. Table 2 shows a summary of the key recommendations included in this guideline.
Question 1. Should dental sealants, when compared with nonuse of sealants, be used in pits and fissures of occlusal surfaces of primary and permanent molars on teeth deemed to have clinically sound occlusal surfaces or noncavitated carious lesions?

**Summary of findings.** Data from 9 randomized controlled trials\(^{24-31}\) showed that in children and adolescents with sound occlusal surfaces, the use of pit-and-fissure sealants compared with nonuse of sealants, reduces the incidence of occlusal carious lesions in permanent molars by 76% after 2 to 3 years of follow-up (odds ratio [OR], 0.24; 95% CI, 0.19-0.30) (eTable 1, available online at the end of this article). In absolute terms, for a population with a caries baseline risk (prevalence) of 30%, 207 carious lesions would be prevented out of 1,000 sealant applications (95% CI, 186-225 fewer lesions) after 2 to 3 years of follow-up. Available data assessing the effect of sealants compared with a control without sealants in a mixed population of patients with sound occlusal surfaces and noncavitated occlusal carious lesions showed that sealants reduced the incidence of carious lesions in this population by 75% (OR, 0.25; 95% CI, 0.19-0.34) after 2 to 3 years of follow-up. The guideline panel determined the overall quality of the evidence for this comparison as moderate owing to serious issues of risk of bias (unclear method for randomization and allocation concealment) in the included studies. No data on the effect of sealants in adult patients were identified.

**Recommendation.** The sealant guideline panel recommends the use of sealants compared with nonuse in primary and permanent molars with both sound occlusal surfaces and noncavitated occlusal carious lesions in children and adolescents. (**Strong recommendation, moderate-quality evidence.**)

**Remarks.**

- No studies were identified regarding the effect of sealants on preventing and arresting occlusal carious lesions in adult patients. For clinicians and patients attempting to extend this recommendation to adults, the guideline panel suggests that similar treatment effects may be expected for other age groups, particularly in adults with a recent history of dental caries. The lack of direct evidence informing this recommendation restrained the guideline panel from formulating a more definitive recommendation in this regard.
- This recommendation is intended to inform clinicians about the benefit of sealing a tooth compared with not sealing it, irrespective of the type of sealant material applied.
- The panel highlighted that a number of studies have shown that sealing children’s and adolescents’ permanent molars reduces costs to the health system by delaying and preventing the need for invasive restorative treatment, particularly when these patients are classified as having an “elevated caries risk” (that is, previous caries experience).\(^{32}\) Under these conditions, dental sealants seem to be a cost-effective intervention.\(^{33-36}\)

- In addition to the evidence collected by the panel from randomized controlled trials suggesting a beneficial effect of sealants in noncavitated occlusal carious lesions, the body of evidence from observational studies shows similar results.\(^{37-38}\)

**Research priorities.**

- Although the analysis was stratified using 2 caries baseline risks (30% caries prevalence in the article and 70% caries prevalence in the tables), the guideline panel acknowledged that clinicians lack a valid and reliable tool to conduct a chairside caries risk assessment, especially when it comes to assessing a specific tooth surface or site. There is a need for such a tool to enable clinicians to perform a more accurate assessment of the patient’s caries risk and to enable the panel to provide more specific recommendations using an accurate patient caries risk estimation.
- The panel highlighted the need for additional studies assessing the effect of sealants in the primary dentition.

Question 2. Should dental sealants, when compared with fluoride varnishes, be used in pits and fissures of occlusal surfaces of primary and permanent molars on teeth deemed to have clinically sound occlusal surfaces or noncavitated carious lesions?

**Summary of findings.** Data from 3 randomized controlled trials\(^{35-38}\) suggest that in children and adolescents with sound occlusal surfaces, the use of pit-and-fissure sealants compared with fluoride varnishes may reduce the incidence of occlusal carious lesions in permanent molars by 73% after 2 to 3 years of follow-up (OR, 0.27; 95% CI, 0.11-0.69) (eTable 2, available online at the end of this article). In absolute terms, for a population with a caries baseline risk (prevalence) of 30%, 196 carious lesions would be prevented out of 1,000 sealant applications (95% CI, 72-255 fewer lesions) when using sealants compared with using fluoride varnish after 2 to 3 years of follow-up. When assessing the effect of sealants compared with fluoride varnishes in a mixed population of patients with sound occlusal surfaces and noncavitated occlusal carious lesions, sealants may reduce the incidence of caries by 34%; however, this difference was not statistically significant (OR, 0.66; \(P = .30\); 95% CI, 0.30-1.44). The guideline panel determined the overall quality of the evidence for this comparison as low owing to serious issues of risk of bias (unclear method for randomization and allocation concealment) and inconsistency. No data on the effect of sealants versus fluoride varnish in adult patients were identified.

**Recommendation.** The sealant guideline panel suggests the use of sealants compared with fluoride varnishes in primary and permanent molars, with both sound occlusal surfaces and noncavitated occlusal carious lesions, in children and adolescents.
(Conditional recommendation, low-quality evidence.)

Research priorities.

- Although the analysis was stratified using 2 caries baseline risks (30% caries prevalence in the article and 70% caries prevalence in the tables), the guideline panel acknowledged that clinicians lack a valid and reliable tool to conduct a chairside caries risk assessment. There is a need for such a tool to enable clinicians to understand the evidence in the context of different caries risk estimations.
- The guideline panel suggests that more research should be conducted on other noninvasive approaches for caries arrest in occlusal surfaces of primary and permanent molars (for example, silver diamine fluoride).

Question 3. Which type of sealant material should be used in pits and fissures of occlusal surfaces of primary and permanent molars on teeth deemed to have clinically sound occlusal surfaces or noncavitated carious lesions in children and adolescents?

Comparison 3.1. GI sealants compared with resin-based sealants.

Summary of findings. Data from 10 randomized controlled trials included in the meta-analysis suggest that in children and adolescents with sound occlusal surfaces, the use of GI sealants compared with resin-based sealants may reduce the incidence of occlusal carious lesions in permanent molars by 3% after 1 to 3 years of follow-up (OR, 0.77; 95% CI, 0.32-1.57); however, this difference was not statistically significant (P = .39) (eTable 3, available online at the end of this article). In absolute terms, for a population with a caries baseline risk (prevalence) of 30%, this means that use of a GI sealant would prevent 67 carious lesions out of 1,000 sealant applications (95% CI, 102 more-179 fewer lesions) compared with using a resin-based sealant after 2 to 3 years of follow-up; however, this difference was not statistically significant. One additional study with 200 participants that we were unable to include in the meta-analysis owing to the data presentation failed to show a clinically or statistically significant difference in caries incidence when GI sealants and resin-based sealants were placed on the occlusal surfaces of primary and permanent molars. When looking at available data assessing the effect of GI sealants compared with resin-based sealants in a population of patients with noncavitated occlusal carious lesions, the data suggest that GI sealants may increase the incidence of carious lesions by 53% (OR, 1.53; 95% CI, 0.58-4.07); however, this difference was not statistically significant (P = .39). When assessing retention, GI sealants may increase the incidence of loss of retention from the tooth compared with resin-based sealants after 2 to 3 years of follow-up (OR, 5.06; 95% CI, 1.81-14.13). The guideline panel determined the overall quality of the evidence for this comparison as very low owing to serious issues of risk of bias (unclear method for randomization and allocation concealment), inconsistency, and imprecision. No data on the effect of GI versus resin-based sealants in adult patients were identified.

Comparison 3.2. Glass ionomer sealants compared with resin-modified GI sealants.

Summary of findings. Data from 1 randomized controlled trial suggest that in children and adolescents with sound occlusal surfaces the use of GI sealants compared with resin-modified GI sealants may increase the incidence of occlusal carious lesions in permanent molars by 41% after 2 to 3 years of follow-up (OR, 1.41; 95% CI, 0.65-3.07); however, this difference was not statistically significant (P = .38) (eTable 4, available online at the end of this article). In absolute terms, for a population with a caries baseline risk (prevalence) of 30%, we are expecting to have 77 more carious lesions over 1,000 sealant applications (95% CI, 82 fewer-268 more lesions) when using GI sealants compared with using a resin-modified glass ionomer sealant after 2 to 3 years of follow-up; however, this difference was not statistically significant. When assessing retention, GI sealants would have 3 times greater risk of experiencing retention loss from the tooth compared with resin-modified glass ionomer sealants after 2 to 3 years of follow-up (OR, 3.21; 95% CI, 1.87-5.51). The guideline panel determined the overall quality of the evidence for this comparison as very low owing to serious issues of risk of bias (unclear method for randomization and allocation concealment), and very serious issues of imprecision. No data on the effect of GI versus resin-modified GI sealants in adult patients were identified.

Comparison 3.3. Resin-modified glass ionomer sealants compared with polyacid-modified resin sealants.

Summary of findings. Data from 1 randomized controlled trial suggest that in children and adolescents with sound occlusal surfaces, the use of resin-modified GI sealants compared with polyacid-modified GI sealants may reduce the incidence of occlusal carious lesions in permanent molars by 56% after 2 to 3 years of follow-up (OR, 0.44; 95% CI, 0.11-1.82); however, this difference was not statistically significant (P = .26) (eTable 5, available online at the end of this article). In absolute terms, for a population with a caries baseline risk (prevalence) of 30% this means that use of resin-modified GI sealants would prevent 141 carious lesions out of 1,000 sealant applications (95% CI, 138 more-255 fewer lesions) compared with the use of polyacid-modified resin sealants after 2 to 3 years of follow-up; but this difference was not statistically significant. When assessing retention, resin-modified GI sealants may increase the risk of loss of retention by 17% compared with polyacid-modified resin sealants after 2 to 3 years of follow-up (OR, 1.17; 95% CI, 0.52-2.66); however, this difference was not statistically significant (P = .70). The guideline panel determined the overall quality of the evidence for this comparison as very low owing to serious issues of risk of bias (unclear method for randomization and allocation concealment), inconsistency, and imprecision. No data on the effect of resin-modified GI versus resin-modified polyacid sealants in adult patients were identified.
Comparison 3.4. Polyacid-modified resin sealants compared with resin-based sealants.

Summary of findings. Data from 2 randomized controlled trials suggest that in children and adolescents with sound occlusal surfaces, the use of polyacid-modified resin sealants compared with resin-based sealants may increase the incidence of occlusal carious lesions in permanent molars by 1% after 2 to 3 years of follow-up (OR, 1.01; 95% CI, 0.48-2.14); however, this difference was not statistically significant (P = .97) (eTable 6, available online at the end of this article). In absolute terms, for a population with a caries baseline risk (prevalence) of 30%, the use of polyacid-modified resin sealant would increase carious lesions by 30% compared with resin-based sealants after 2 to 3 years of follow-up; however, this difference was not statistically significant. When assessing the outcome retention, polyacid-modified resin sealants seem to reduce the risk of loss of retention by 13% compared with resin-based sealants after 2 to 3 years of follow-up (OR, 0.87; 95% CI, 0.12-6.21); however, this difference was not statistically significant (P = .89). The guideline panel determined the overall quality of the evidence for this comparison as very low owing to serious issues of risk of bias (unclear method for randomization and allocation concealment) and very serious issues of imprecision. No data on the effect of polyacid-modified resin versus resin-based sealants in adult patients were identified.

Recommendation. The panel was unable to determine superiority of 1 type of sealant over another owing to the very low quality of evidence for comparative studies. The panel recommends that any of the materials evaluated (for example, resin-based sealants, resin-modified GI sealants, GI cements, and polyacid-modified resin sealants in no particular order) can be used for application in permanent molars with both sound occlusal surfaces and noncavitated occlusal carious lesions in children and adolescents. (Conditional recommendation, very low-quality evidence.)

Remarks.

The head-to-head analyses of all comparisons did not allow the guideline panel to provide specific recommendations using a hierarchy of effectiveness for the sealant materials. In addition, the quality of the evidence across head-to-head comparisons was assessed to be low to very low at best. The guideline panel suggests that clinicians take into account the likelihood of experiencing lack of retention when choosing the type of sealant material most appropriate for a specific patient and clinical scenario. For example, in situations in which dry isolation is difficult, such as a tooth that is not fully erupted and has soft tissue impinging on the area to be sealed, then a material that is more hydrophilic (for example, GI) would be preferable to a hydrophobic resin-based sealant. On the other hand, if the tooth can be isolated to ensure a dry site and long-term retention is desired, then a resin-based sealant may be preferable.

The lack of reporting in relation to resealing did not allow the panel to include this as 1 more element for decision making. However, it can be inferred from the data on retention loss that clinicians may need to monitor sealants showing a higher risk of experiencing retention loss more often.

To obtain optimal levels of retention, the guideline panel suggests clinicians carefully follow the manufacturers’ instructions for each type of sealant material.

Research priorities.

The panel urges the research community to conduct high-quality randomized controlled trials to understand further the relative merits of the different types of sealant materials. Such studies should meet the optimal information size to reduce the very serious issues of imprecision affecting this body of evidence.

New trials should improve reporting quality to allow the panel to conduct a more accurate assessment of the risk of bias.

Further research is needed to understand the role of different types of sealant materials in the primary dentition and adult population.

Although the analysis conducted was stratified using 2 caries baseline risks (30% caries prevalence in the article and 70% caries prevalence in the tables), the guideline panel acknowledged that clinicians lack a reliable and valid chairside tool to conduct a caries risk assessment. There is a need for such a tool to enable clinicians to extrapolate the results from this analysis to their patients in a more accurate manner.

The poor quality or complete lack of reporting in relation to resealing prevented the panel from using this information during the decision-making process. The panel highlighted the need for improving the report of reapplication of sealants as 1 more relevant outcome in primary studies assessing the effect of this intervention.

Question 4. Are there any adverse events when using pit-and-fissure sealants?

Summary of findings. There has been concern that dental sealants might exhibit adverse effects. This is primarily associated with bisphenol A (BPA). It has been suggested that the BPA present in some sealants may have estrogen-like effects. It has been suggested that the BPA present in some sealants may have estrogen-like effects; however, the evidence does not support the transient effect of a small amount of BPA in placing patients at risk. Studies have evaluated the correlation of developing carious lesions in teeth with fully or partially lost sealants and found no greater risk than in teeth that had never been sealed. Two
randomized controlled trials measuring the occurrence of adverse effects associated with sealants found no events related to this outcome. 87-96, 97

CONCLUSIONS
The evidence shows that sealants available in the US market at the time of this systematic review are an effective intervention for reducing the incidence of carious lesions in the occlusal surfaces of primary and permanent molars in children and adolescents compared with the nonuse of sealants or fluoride varnishes. This benefit is inclusive to both sound occlusal surfaces and noncavitated occlusal carious lesions. Clinicians should use these recommendations but consider carefully individual patient factors, especially where the guideline panel offered conditional recommendations. In addition, sealant use should be increased along with other preventive interventions to manage the caries disease process, especially in patients with an elevated risk of developing caries. Further research is needed to provide more risk-oriented recommendations, particularly regarding the development of a valid and reliable chairside tool for clinicians to assess a patient’s caries risk.  ■

SUPPLEMENTAL DATA
Supplemental data related to this article can be found at http://dx.doi.org/10.1016/j.adaj.2016.06.001.

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Program Implementation and Outreach Protocol

All school-based sealant program staff should use the following steps to implement the I-Smile™ @ School program in new schools. These steps will ensure a uniform process of school outreach and program execution.

Step 1. Contact Superintendent
Once the targeted school(s) for the I-Smile™ @ School program has been identified, send the following information to the school district superintendent to describe the program and its intent:

- Introductory letter
- I-Smile™ @ School Fact Sheet
- I-Smile™ @ School Questions and Answers for School Staff

A Sample Letter to Superintendents template may be found on page 905.1.

Approximately 10 days after the letter is sent, provide a follow-up call to the superintendent to confirm their support.

Step 2. Contact Principal
Once a superintendent has agreed to participate in the I-Smile™ @ School program, contact the school principal to provide the following program information:

- Introductory letter (with “carbon copy” to the school nurse)
- I-Smile™ @ School Fact Sheet
- I-Smile™ @ School Questions and Answers for School Staff
- Blank consent form

A Sample Letter to Principals template may be found on page 906.1. The I-Smile™ @ School Fact Sheets may be found on pages 902.1 and 903.1. The I-Smile™ @ School Questions and Answers for School Staff form may be found on page 904.1.

Approximately 10 days after the letter is sent, provide a follow-up call to the principal to confirm the letter was received and confirm school contact information and dates. Class lists of targeted grades should be requested at this time, which should include teacher names.

Step 3. Contact School Nurse to schedule
Schedule a date for the program as far in advance as possible to allow for sufficient time to distribute and collect consent forms, educate school staff, and prepare materials. Check with the principal, school nurse, teachers, and/or secretary to ensure there are no field trips, special testing, special guests, parties, etc., scheduled for the classes and/or children being served.

Step 4. Provide Teacher information
At least one month prior to the start of the I-Smile™ @ School program, provide the following information to all teachers whose classrooms are participating:

- Introductory letter
- I-Smile™ @ School Fact Sheet
- I-Smile™ @ School Questions and Answers for School Staff
- Consent packets
The Sample Letter to Teachers template may be found on page 907.1.

Refer to Steps 6 and 7 below for consent packet distribution and collection. An emphasis should be placed on collecting all consents, whether or not the student participates in the program. Incentives, such as stickers, pencils and other low-cost items, are encouraged to be used when collecting consent forms.

**Step 5. Contact Community Dentists**

Notify all dentists in the community to make them aware of the I-Smile™ @ School program and the services it provides. It is crucial to maintain positive working relationships.

The Sample Letter to Dentists template may be found on page 908.1.

**Step 6. Consent packet distribution**

At least one month prior to the I-Smile™ @ School program start date, remind teachers that consent packets should be sent home to parents. Consent packets should include:

- Introductory letter
- Consent form
- I-Smile™ @ School Fact Sheet

The Sample Letter to Parents template may be found on page 909.1.

**Step 7. Collection of consent forms**

At least two weeks before the program is scheduled to begin, collect all consent forms. This will allow adequate time to review all forms for completion. Program staff should ensure all pertinent information is present and all parent/guardian signatures are completed in ink.

**Step 8. Preparation for sealant clinic**

Ensure all schedules, class lists, and consent forms are organized and ready when the program begins. I-Smile™ @ School staff are expected to follow the school’s ‘Visitor’ rules, which often includes wearing a visible name tag and signing in and out of the school. School staff should be notified of the I-Smile™ @ School staff estimated arrival and departure times for the duration of the program.

I-Smile™ @ School staff should also be familiar with the school’s emergency response plan to ensure the safety of themselves and the students.
What is I-Smile™ @ School?
I-Smile™ @ School is a dental program that provides no-cost dental screenings, dental sealants, fluoride varnish, and education for students. This dental program takes place during the school day and students miss very little class time.

Why is dental care so important?
Cavities can impact a student’s ability to learn, eat, and speak properly, sleep, and build self-confidence. Dental sealants and fluoride varnish help protect the teeth and prevent cavities. They save time, money and the discomfort related to cavities and are important for your child’s health!

What is a dental screening?
• A dental screening is a simple look in the mouth to check the condition of the teeth and determine if dental sealants or fluoride varnish are needed.
• A dental screening does not take the place of a dental checkup at a dental office.

What are dental sealants?
• A dental sealant is a tooth-colored material that is applied to the chewing surfaces of back teeth.
• Sealants protect teeth from germs and food that can cause cavities.

When should a child’s teeth be sealed?
• A child’s back teeth should be sealed as soon as they erupt. These teeth usually come in around the ages of 6 and 12 years.

How are dental sealants applied?
• Applying sealants is simple and painless.
• The teeth are cleaned and the sealant liquid is painted in the grooves of the chewing surfaces with a small brush.

How long do dental sealants last?
• Sealants can last for many years if your child takes good care of his or her teeth.
• Sealants should be checked at each dental visit and reapplied if needed.

What is fluoride varnish?
• Fluoride varnish is a sticky liquid that is quickly and easily applied to all tooth surfaces.
• It tastes good and should be applied 2-4 times each year to reduce a child’s risk of cavities.

How much do these services cost?
• All I-Smile™ @ School program services are provided at no-cost.

Contact information
Bureau of Oral & Health Delivery Systems
Iowa Department of Public Health
1-866-528-4020

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¿Qué es I-Smile™ @ School?
I-Smile™ @ School es un programa dental que proporciona evaluaciones dentales, selladores dentales, barniz de flúor y educación para los estudiantes sin costo. Este programa dental se lleva a cabo durante la jornada escolar y los estudiantes pierden muy poco tiempo de clase.

¿Por qué es tan importante el cuidado dental?
Las caries pueden afectar la capacidad de un estudiante para aprender, comer y hablar adecuadamente, dormir y desarrollar la confianza en sí mismo. Los selladores dentales y el barniz de flúor ayudan a proteger los dientes y prevenir las caries. Estos ahorran tiempo, dinero y alivian las molestias relacionadas con las caries, y son importantes para la salud de su hijo.

¿Qué es una evaluación dental?
• Una evaluación dental es una simple revisión de la boca para ver en qué estado están los dientes y determinar si se necesitan selladores dentales o barniz de flúor.
• La evaluación dental no sustituye el control odontológico en un consultorio dental.

¿Qué son los selladores dentales?
• Un sellador dental es un material de color similar al de los dientes que se aplica sobre la superficie de masticación de las muelas.
• Los selladores protegen los dientes contra los gérmenes y la comida que pueden causar caries.

¿Cuándo deben sellarse los dientes de un niño?
• Las muelas de un niño se deberían sellar ni bien erupcionan. Estos dientes suelen salir entre los 6 y los 12 años de edad.

¿Cómo se aplican los selladores dentales?
• La aplicación de los selladores es simple e indolora.
• Se limpian los dientes y se pasa el sellador líquido con un pincel pequeño en las hendiduras de las superficies de masticación.

¿Cuánto tiempo duran los selladores dentales?
• Si su hijo se cuida bien los dientes, los selladores pueden durar muchos años.
• Los selladores deben revisarse en cada consulta dental y volver a aplicarse si fuera necesario.

¿Qué es el barniz de flúor?
• El barniz de flúor es un líquido pegajoso que se aplica rápida y fácilmente en todas las superficies de los dientes.
• Tiene buen sabor y se debe aplicar de 2 a 4 veces al año para disminuir el riesgo de caries del niño.

¿Cuánto cuestan estos servicios?
• Todos los servicios del programa I-Smile™ @ School se proporcionan sin costo.

I-Smile™ @ School
QUESTIONS AND ANSWERS FOR SCHOOL STAFF

What is the I-Smile™ @ School Program?
I-Smile™ @ School is a preventive dental program that focuses on improving the oral health of Iowa’s students. The program provides dental screenings, dental sealants, fluoride varnish, and age-appropriate oral health education. Iowa licensed dental hygienists and/or dentists provide all I-Smile™ @ School services.

The Iowa Department of Public Health has provided oversight for school-based oral health programs for more than 15 years. There are I-Smile™ @ School programs in most of Iowa’s 99 counties. All I-Smile™ @ School programs are held to high standards as determined by peer-reviewed research and Centers for Disease Control and Prevention (CDC) recommendations.

How long are students absent from the classroom?
The amount of time a student is away from the class will vary depending on the services provided. Each “appointment” is long enough to provide quality and compassionate dental care, individualized for each child. Since the services are provided within the school, each “appointment” takes much less time than traveling to a dental appointment outside of the school.

A student receiving dental services may be absent from the classroom for 15-30 minutes. I-Smile™ @ School recognizes that this may affect some students differently than others and will work with school staff to ensure students miss the least amount of time in the most appropriate part of the school day.

How is follow-up care provided?
All I-Smile™ @ School programs will encounter children with dental needs. Program staff provide referrals for all children and will work with school staff, families, and local dental providers to ensure treatment needs are met. The goal is that all children will have access to a regular source of dental care.

Where will the services be provided in the school?
I-Smile™ @ School staff will set up mobile equipment wherever there is a private, convenient room or space that can be disinfected and is near an electrical outlet. Empty classrooms, stages, lunchrooms or other areas are most commonly used. Each I-Smile™ @ School program provides their own equipment, but may ask to use school items such as tables or chairs.

How long will program staff be at the school?
The length of time program staff will be at a school will depend on the number of students with positive consent to be served. Most programs will be completed within one to two weeks, depending on the length of the school week and other school activities. I-Smile™ @ School equipment is generally taken down and removed from the school at the completion of the program. If needed, the equipment can be moved to accommodate special school events or if there is a lapse of time between services provided.

What does a student need to participate in the program?
Students must have active consent from a parent/guardian to participate in the I-Smile™ @ School program. Consent forms are provided by the program and gathered by the school. Medicaid dental insurance information is collected, if applicable. There is no cost for the services, so no payment is collected.

Contact information
Bureau of Oral and Health Delivery Systems
Iowa Department of Public Health
1-866-528-4020

9/2017
7/2015
Sample Letter to Superintendents

{Date}

Dear Superintendent,

{Name of School} has been selected to participate in the I-Smile™ @ School program – an exciting opportunity for students and staff!

I-Smile™ @ School is a program that focuses on preventing tooth decay and improving oral health for students. The program provides **FREE** dental screenings, fluoride varnish, dental sealants and age-appropriate oral health education. School-based programs are effective and have been recommended by the Centers for Disease Control and Prevention (CDC), American Dental Association and the Community Preventive Services Task Force. Iowa licensed dental hygienists and/or dentists provide all of the services.

Tooth decay is a silent epidemic that is very common and largely preventable. According to the CDC, 60 percent of children under age 15 have experienced tooth decay, which causes an estimated 51.7 million lost hours of school time each year nationally.¹

It is the goal of every school to promote academic success and well-being for each student. Participation in the I-Smile™ @ School program is a win-win for the school and families – it is a community partnership that will allow the school to offer preventive care for students and promote health and success.

Please see the attached *I-Smile™ @ School Fact Sheet* and *I-Smile™ @ School Questions and Answers for School Staff* for more details about the program.

I will follow-up with you in the next week to answer any questions you might have and to confirm that {school name} will participate in the program. We look forward to partnering with your school staff to promote health, well-being, and academic success for all students!

Sincerely,

{Sealant Program Coordinator}
{Contact Information}

Enclosures:
*I-Smile™ @ School Fact Sheet*
*I-Smile™ @ School Questions and Answers for School Staff*

Dear Principal,

The I-Smile™ @ School program is pleased that {Name of school} will participate in our preventive dental service program. This letter and the enclosed documents will provide you with a better understanding of our program and how it might work in your school.

I-Smile™ @ School is a program that focuses on preventing tooth decay and improving oral health for children. The program provides FREE dental screenings, fluoride varnish, dental sealants and age-appropriate oral health education. School-based programs are effective and have been recommended by the Centers for Disease Control and Prevention (CDC), American Dental Association and the Community Preventive Services Task Force. Iowa licensed dental hygienists and/or dentists provide all of the services.

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Please see the attached I-Smile™ @ School Fact Sheet and I-Smile™ @ School Questions and Answers for School Staff for more details about the program.

I will follow-up with you in the next week to answer any questions you might have and to find out who the school contact person will be.

We look forward to partnering with you and your staff to promote health, well-being, and academic success for all students!

Sincerely,

{Sealant Program Coordinator}
{Contact Information}

Enclosures:
I-Smile™ @ School Fact Sheet
I-Smile™ @ School Questions and Answers for School Staff

Cc: School nurse

I-Smile @ School Logo

{Date}

Dear Teachers,

Success in the classroom is often impacted by oral health. Tooth decay is the single most common chronic childhood disease—five times more common than asthma,¹ four times more common than early childhood obesity, and 20 times more common than diabetes.² Poor oral health impacts a child’s ability to eat, thrive, and grow; to concentrate and learn new skills; to speak properly; and to have self-confidence.

The I-Smile™ @ School program will be at {school name} to provide preventive dental services to all students in the {list} grades. Please see the attached I-Smile™ @ School Questions and Answers for School Staff for details about the I-Smile™ @ School program.

The I-Smile™ @ School services are FREE to the student and the school. The only requirement is that students must provide a signed consent from their parent or guardian to participate. To ensure full student participation, your help with consent distribution and collection is crucial and very much appreciated. Please distribute the consent forms no later than {date}.

I have provided the school with {items} as an incentive to distribute to each student who returns a consent form. Please periodically remind your students to return the consent forms so that they can receive the incentive and participate in this program to improve their health! Please collect all consent forms by {date}.

Thank you in advance for your support of the I-Smile™ @ School program. These preventive services are critical for oral health and overall health and will have an impact for many years, providing all students with the opportunity to learn and succeed.

The attached I-Smile™ @ School Fact Sheet and I-Smile™ @ School Questions and Answers for School Staff should answer many, if not all, of your questions. If you have additional questions, please do not hesitate to contact me.

Sincerely,

{Sealant Program Coordinator}
{Contact information}

Enclosures:
I-Smile™ @ School Fact Sheet
I-Smile™ @ School Questions and Answers for School Staff

² http://www.mychildrensteeth.org/assets/2/7/ECCstats.pdf
Dear Dentist,

I am writing to share that I-Smile™ @ School, a school-based oral health program, will soon be providing preventive dental services at a school in your community.

As you know, dental caries remains the most common chronic childhood illness. According to the most recent (2011-2012) National Health and Nutrition Examination Survey (NHANES), 56 percent of children ages 6 to 8 have experienced dental caries in their primary teeth,¹ and more than 28 percent of children ages 9 to 11 experienced tooth decay in a permanent tooth.² Caries prevalence remains higher in children from lower-socioeconomic and minority families, as they face the most challenges in receiving dental care with barriers such as transportation, cost, and lack of oral health awareness.

The I-Smile™ @ School program aims to eliminate some of these barriers by providing no-cost services at schools with children at higher-risk of decay. These services include dental screenings, fluoride varnish applications, dental sealants and oral health education. By providing school-based services at no cost, the program is able to eliminate a parent’s struggle to take time off work to take a child to an appointment, to find transportation, or to afford preventive care. In addition, classroom and parent education helps to increase awareness of the importance of oral health and regular dental care.

I-Smile™ @ School is not in every county, town or school in Iowa. In fact, schools selected for the program generally have a 40 percent or higher free and reduced lunch program rate. By selecting schools with a higher percentage of low-income students, we are better able to reach those children needing our services the most.

Every child who participates in the I-Smile™ @ School program is referred to a dentist for treatment and regular care. For those children without a regular dentist, the program provides care coordination to help families find a dentist and assist with transportation and insurance or payment issues.

Please feel free to contact me with any questions. The I-Smile™ @ School program looks forward to partnering with you to improve the health of our children!

Sincerely,

{Sealant Program Coordinator}
{Contact Information}

Dear Parent/Guardian:

The {agency} I-Smile™ @ School program is offering no-cost dental services on {date} for children in the {insert number} grade{s} at {school name}.

The following services may be provided by dentists and/or dental hygienists:
- Dental Screening – a simple look in the mouth to check for cavities.
- Fluoride Varnish – a sticky liquid that coats all teeth to help make them stronger and prevent tooth decay.
- Dental Sealants – a tooth-colored coating that is painted on the back teeth to protect them from food, germs, and acid that cause tooth decay.
- Oral Health Education – lessons to help students learn about healthy teeth and mouths.

After the services are provided to your child, a letter will be sent to you with the results. Please note that dental screenings do not replace regular dental check-ups. Your child should visit the dentist at least once a year for a complete exam.

A consent form is attached and must be completed and signed by a parent/guardian. It is very important that the consent form is returned to the school no later than {due date} to ensure that your child is able to participate.

Please see the attached I-Smile™ @ School Fact Sheet for additional information. You may contact me with any questions at the phone number listed below.

Sincerely,

{Sealant Program Coordinator name}

{Contact information}

Enclosures:
Consent
I-Smile™ @ School Fact Sheet
Oral Health Education Curriculum

Classroom education should be provided within all schools participating in the I-Smile®@ School Program. **At a minimum, oral health education is required for all 2nd and 3rd grade classrooms in schools with 40% or greater free/reduced lunch rates.** To standardize lesson plans and ensure consistent information is provided, the following American Dental Association (ADA) programs have been selected for use by program staff (with permission from the ADA). This information is age specific and will provide comprehensive oral health education, activities and demonstrations.

**2nd and 3rd Grade:** *A Lifetime of Healthy Smiles!*
- Tiny Teeth Do Big Jobs
- Plaque Attack
- You Have Power

**4th through 6th Grade:** *Teeth to Treasure!*
- Protect your Prized Possession
- Extra Protection for Terrific Teeth

**7th and 8th Grade:** *Watch Your Mouth!*
- Be Smart About Your Smile
- Going the Extra Smile

Module 1: “Tiny Teeth Do Big Jobs!” 10-15 minutes

Key Message
Teeth are important for eating, talking and having a nice smile.

Student goals
Upon completing this module students will better understand:
• Why people have teeth.
• How we use our teeth.
• How many sets of teeth people get.

Module Topics (with discussion points and questions)

1. Why we need teeth. Who can name something that we do with our teeth? [Discuss children’s suggestions, which may include talking, eating or chewing, smiling, singing. Have children talk, chew, and smile and frown at each other.] Today we are going to talk about a very important part of our bodies — our teeth. Teeth help us do many things.

2. How teeth help us do things better. We have had some good suggestions. But how do our teeth help us do these things? How do our teeth help us eat? [We can chew our food into little pieces. This keeps us from choking or getting a stomach ache.]

ACTIVITY #1: What about talking? Is it easy to talk without using your teeth? Let’s try it. Say “thirty-three thirsty thieves” without letting your tongue touch your teeth... That was very hard to do! Our teeth have the important job of helping our lips and tongue make sounds properly. I have another question. Do you think you need your teeth to frown? Let’s test it out. Turn to your neighbor and give a great big smile... Good. Now, give your neighbor a very unhappy frown... H-m-m-m. I guess you don’t need teeth to frown! But since most of you laugh and smile a lot, your teeth are very important!

So now we know that:
Our teeth are important because they help us talk properly, chew our food and give us beautiful smiles!

3. Characteristics of teeth. What are your teeth like? Are they soft or hard? Do they have sharp edges or are they round like a ball? Are they strong or do they break easily? [Discuss answers.] So, our teeth are hard, have some sharp or cutting edges, and are strong. What would happen if our teeth were soft and weak? [Couldn’t chew; they might break; it would be hard to talk.]
4. *The number and purpose of baby (primary) teeth.* When did you get your teeth? [When you were a baby.] Why do babies need teeth? [To learn how to talk and so that they can eat solid food.] Now I have a really hard question. How many baby teeth do children get? Any guesses?

**ACTIVITY #2: Primary Tooth Development.** Here is a picture that shows all the teeth in the top of your mouth and in the bottom. Let's count them together out loud... Twenty teeth! That's a lot. By the time children are three or four years old, they have 20 teeth.

Children get 20 teeth by the time they are 3 or 4 years old.

5. *Sets of teeth in a lifetime.* Will you have these 20 teeth your whole life? [No.] What happens to your teeth when you get to be 5, 6 or 7 years old? [Your teeth start to come out.] Yes, your baby teeth start to come out. Why do you lose your baby teeth? [As children get bigger they need bigger, stronger teeth.] (First grade teachers may want to discuss losing primary teeth and getting permanent teeth in more detail. Visit www.adacatalog.org for supplemental materials.)

**ACTIVITY #3:** Look at the size and number of teeth in the photo of the smiling adult and baby. Ask children to imagine all those big teeth in the baby’s little mouth. (Use to illustrate why we need baby teeth.) Talk about things that babies cannot do because they don’t have many teeth.

6. *Permanent teeth.* When you get older, your 20 baby teeth will be replaced by 32 permanent teeth. Your permanent teeth are bigger and stronger than your baby teeth. After all, they are made to last the rest of your life!

People get two sets of teeth during their life: baby teeth (or primary teeth) and adult teeth (or permanent teeth).

**Summary:** Teeth are a special part of our body and do several very important jobs throughout our lives.
Primary Tooth Development

**Upper Teeth**
- Central incisor: Erupt 8-12 mos., Shed 6-7 yrs.
- Canine (cuspid): Erupt 16-22 mos., Shed 10-12 yrs.

**Lower Teeth**
- First molar: Erupt 14-18 mos., Shed 9-11 yrs.
- Canine (cuspid): Erupt 17-23 mos., Shed 9-12 yrs.
- Lateral incisor: Erupt 10-16 mos., Shed 7-8 yrs.
- Central incisor: Erupt 6-10 mos., Shed 6-7 yrs.
Module 2: “Plaque Attack!” approximate time: 7 minutes

Key Message
Plaque can hurt teeth by making acids that cause cavities.

Student goals
Upon completing this module students should know:

• What plaque is.
• How plaque can harm teeth.
• What a cavity is.

Module Topics (with discussion points and questions)

1. Healthy teeth. Do everyone’s teeth always stay strong and healthy? [Solicit a few stories].

2. Things that prevent teeth from staying healthy. What can happen to teeth that keeps them from staying healthy? [They get cavities, they can get broken or knocked out.]

3. What a cavity is. Let’s talk about cavities and what causes them. What is a cavity? [A little hole in your tooth.]

A cavity is a small hole in a tooth.

4. What plaque is. Does anyone know what causes cavities? [You may get a variety of answers, but they may not include plaque.] Those are all interesting answers, but there is one thing that plays a big part in causing decay, or cavities, in your teeth. It is called “plaque.” [Write “plaque” on chalkboard.] Has anyone heard that word before? If you do not brush your teeth before you go to bed at night, how does your mouth feel when you wake up in the morning? [Tastes bad, smells bad, teeth feel sticky or “fuzzy.”] That is because plaque has been forming in your mouth all night. Plaque is a sticky, clear film that is forming on your teeth all the time.

Plaque is a sticky, clear film that is constantly forming on your teeth.

5. How plaque contributes to decay. Plaque is bad for your teeth because it contains germs. When a person eats or drinks sugary or starchy foods, the sugars and plaque mix together to make an acid. Does anyone know what acid does? [It makes holes in things.] The acids in your mouth attack your teeth and can make cavities.
The sugars and the germs in plaque mix together to make acid. The acids in your mouth attack your teeth and can make cavities.

6. Repeated acid attacks make cavities grow. Every time a person eats or drinks, plaque and sugar mix together to make acid. Each acid attack can last 20 minutes, and make a cavity get bigger and bigger. Let’s do a demonstration to help us understand how a cavity grows.

Repeated acid attacks make cavities grow bigger.

**ACTIVITY #2: How a Cavity Grows.** Draw a large tooth on a paper towel with a crayon or permanent marker. Using a black watercolor marker, make a heavy dot on the tooth to represent a cavity. Add a drop of water to the cavity to represent another acid attack. After a few minutes look at the tooth and see how the “cavity” has spread.

7. Repairing cavities. What happens when someone gets a cavity? Does it heal itself like a scrape or cut on your knee? [No. You have to go to the dentist to get it fixed.] That’s right, only your dentist can fix a cavity, by removing the decay and putting a special filling material in the hole.

Cavities cannot go away by themselves. They must be fixed by a dentist.

**Summary:** Plaque and acid can hurt your teeth, making holes that are called cavities.
Module 3: “YOU have the Power!“
approximate time: 15 minutes

Key Message
A healthy mouth and teeth are important parts of a healthy body. There are many things that children can do to keep their teeth clean, strong and healthy.

Student goals
Upon completing this module students should be aware of four steps for good oral health:
- Brush with fluoride toothpaste twice each day. Spit out all the toothpaste!
- Floss once a day with a grown-up’s help.
- Eat and drink nutritious foods and beverages and limit snacks.
- Visit their dentist regularly.

Module Topics (with discussion points and questions)

1. Feeling healthy. How do you feel when you are healthy? [List things: feel strong, have lots of energy, feel happy, etc.] Can someone really be healthy if their mouth and teeth are not healthy? [No.] Why not? [Because a clean mouth feels nicer, your breath smells nice, etc.]

   Healthy teeth and mouth are part of a healthy body.

2. Keeping teeth healthy. What can you do to fight plaque and help keep your teeth healthy? [List answers, which may include brushing, visiting the dentist, good food and drink choices and flossing.] Let’s talk about some of these.

3. Proper brushing. How many of you brush your teeth? Great! How often should you brush your teeth? [Twice a day.] What do you put on your toothbrush? Yes, toothpaste. Why do you use toothpaste? [Cleans better than water, gets the food and plaque off your teeth, makes your breath smell good, makes your mouth taste good.] Those are all good answers. There is also something very important in most toothpastes that helps strengthen your teeth. Does anyone know what it is called? It’s “fluoride.” [Write “fluoride” on chalkboard.] Fluoride prevents cavities by strengthening and protecting the teeth from acid. By the way, after you’ve brushed your teeth, spit out all the toothpaste! Don’t swallow it. Toothpaste is for cleaning your teeth, not your stomach!
Brush twice a day with a fluoride toothpaste.
Fluoride prevents cavities by strengthening and protecting tooth enamel.
Always spit out all the toothpaste!

Did your dentist, or the hygienist in your dentist’s office, show you how to brush your teeth? Move the brush back and forth gently in short strokes. Brush the top, front, and back sides of each tooth.

[NOTE: Ideally, an adult will brush and floss a child's teeth until he or she is at least 6 years old. By age 6 or 7, children should be able to brush their own teeth twice a day – with supervision until about age 10 or 11 — to make sure they are doing a thorough job. Since adults at home do not always supervise tooth brushing, you might want to suggest to your class that they ask a grown-up to watch them brush, so they can show how well they do it! Flossing demands more manual dexterity than very young children have, and children are not usually able to floss well until they are age 10 or 11, and even then they should be supervised.]

ACTIVITY #3: Here is a picture of one good way to brush your teeth. It says...
(Show How to Brush and read instructions. Ask for questions and comments.)

Move the brush back and forth gently in short strokes.
Brush the top, front and back sides of each tooth.

4. Toothbrushes. What kind of toothbrush do you use? [Get several answers.] I'm going to ask you a question and give you four answers. You tell me which answer you think is the right one. (Pass around a couple of toothbrushes in adult and child sizes, or show Adult and Child-size Toothbrushes.) Here's the question:

What kind of toothbrush would be easiest for you use?
   a) The biggest one you can find
   b) One with a fancy handle
   c) A child-size toothbrush that is easy to hold
   d) A purple one

You’re so smart! You should use a child-size toothbrush that is easy to hold.

Use a toothbrush that has soft bristles and is comfortable to use.
ACTIVITY #4: (Show Old and New Toothbrushes and discuss when to get a new toothbrush.) Here are two toothbrushes. Which one looks new? How can you tell if you need a new toothbrush? [If the bristles are bent or broken.] Yes, you should get a new toothbrush when the bristles are bent and worn out.

Replace your toothbrush when the bristles are bent and worn out.

5. Flossing. Is there anything else we can do to clean our teeth? [Use floss.] Who knows what dental floss is? [Looks like string or thread.] Dental floss is a special kind of string for cleaning between your teeth. How many of you floss your teeth? Cleaning between your teeth is just as important as brushing. Do you know WHY? [Flossing helps remove bits of food and plaque from between the teeth where your toothbrush can’t reach. It helps keep your teeth and gums healthy.] Flossing is not as easy for children to do as brushing, so you should ask your parents or another grown-up to help you floss. You should floss your teeth very gently, once a day.

Floss your teeth very gently, once a day, with a grown-up’s help.

ACTIVITY #5: Show floss and explain the technique used in How to Floss. Ask for a student volunteer, and demonstrate the following flossing technique using yarn: The child holds hands together with fingers straight up and tight against each other. These are the teeth. Use the yarn to floss between the student’s fingers. Arrange students in pairs, give each pair a length of yarn, and allow them time to practice “flossing” each other’s fingers. (One variation of this is to smear tempera paint between the fingers of the child representing the teeth, and then use the yarn to “floss.” In this way, the children will actually see the “floss” cleaning between the teeth.)

5. Good nutrition. Brushing and flossing are very important ways to keep teeth clean and healthy, but there are a few more things that each of us can do. Any ideas? I’ll give you two hints: It has to do with plaque and germs and ACID. It also has to do with keeping the rest of your body healthy. Yes. The foods we eat and the beverages we drink are very important for keeping our teeth healthy. So let’s talk about food.
ACTIVITY #8: Nutritious Foods. Does anyone know (remember) the food groups? [List on board.] Eating a mix of foods from these groups for breakfast, lunch and dinner is the best way to keep your teeth and whole body in good shape. [Discuss healthy eating for a few minutes.] (Visit www.mypyramid.gov for resources.)

But what about snacks, soda pop, and sweets? [Get opinions.] Who remembers what happens in our mouths after we eat? Yes, plaque and sugar mix to form acid. Then the acid attacks our teeth. The more often we eat snacks and drink sugary liquids, the more acid attacks we have. But that doesn’t mean that all snacks are bad for you. Sometimes growing children need to eat between meals. If you are hungry and need a snack, choose nutritious foods like fruit, low-fat cheese, low-fat yogurt or raw vegetables. Save the sweets to eat and drink with your meals. A full meal produces lots of saliva in your mouth that helps wash away the acids from your teeth.

Eating a nutritious mix of foods from the food groups is the best way to keep your teeth and body healthy. If you have sweets, eat or drink them with your meals. If you snack, eat nutritious foods.

What about chewing gum? [Get opinions.] Chewing gum immediately after a meal or snack is okay as long as the gum is sugarless. In fact, sugar-free gum makes your mouth produce more water, called saliva, which can help rinse the acid off your teeth. Of course, if your parents don’t like you chewing gum, then you shouldn’t, and we never chew gum in school. And — don’t forget — throw your gum away in a trash can when you are finished!

Chewing sugarless gum increases saliva and helps wash out food and acid.

6. Protect your teeth! Another way to keep your teeth in good shape is NOT to chew on hard things — like ice cubes, pencils, or hard candy. Your teeth are strong, but it is possible to crack or chip them. It’s a good habit to keep things out of your mouth that don’t belong there!

Don’t chew on hard objects like pencils, ice cubes or hard candy.
7. Dental visits. So now we know four important ways to take care of our teeth — brushing, flossing, eating nutritious foods and not chewing on hard objects. There is one more very important thing we should all do to keep our teeth healthy. Who can tell me what it is? Yes! Visit your dentist regularly. Your dentist will tell you when your next visit should be. What are some of the ways the dentist helps you take care of your teeth? [Checks your teeth to see if they are healthy. Tells you how to take good care of your teeth. Fixes cavities and repairs teeth.] Great! [If time allows, discuss the children’s experiences at the dentist’s office.]

Visit your dentist regularly.

We have learned a lot about our teeth today and how to take good care of them.
1. Our teeth are important.
2. Healthy teeth are part of a healthy body.
3. Taking good care of our teeth is something that each of us can do.

Summary: Healthy teeth can last a lifetime if they are cared for properly.

ACTIVITY #9: Have students work individually or in pairs to complete the activity sheets A-MAZE-ing Message and Something’s Missing.
How to Brush

• Place the toothbrush at a 45-degree angle to the gums.

• Move the brush back and forth gently in short strokes.

• Brush the outer surfaces, the inside surfaces and the chewing surfaces of all teeth.

• To clean the inside surface of the front teeth, tilt the brush vertically and make several up-and-down strokes.

• Brush your tongue to remove bacteria and keep your breath fresh.
Adult and Child-Size Toothbrushes

Which one would be easiest for him to use?
Old & New Toothbrushes
How to Floss

- Use about 18 inches of floss wound around one of your middle fingers, with the rest wound around the opposite middle finger.

- Hold the floss tightly between the thumbs and forefingers and gently insert it between the teeth.

- Curve the floss into a “C” shape against the side of the tooth.

- Rub the floss gently up and down, keeping it pressed against the tooth. Don’t jerk or snap the floss.

- Floss all your teeth. Don’t forget to floss behind your back teeth.
A-MAZE-ing Message

There is a message hidden in the tooth. Start at the star and follow the arrows. Write down the letters on the spaces below as you come to them. A smile means the end of a word. The next letter starts a new word.

_ _ _ _ _   _ _ _  _ _ _ _ _ _ _ _ !
Something’s Missing

All the vowels (a, e, i, o, u) are missing from these dental words. How many can you complete in two minutes? (The answers are at the bottom of the page.)

br_sh

c_v_t_y

ch_w

c_l__n

d_c_y

d_nt_st

fl_ss

fl__r_d_

f__d

g_m_s

j_w_s

m__t_h

m__t_h_g__r_d

n__r_t__n

p_l_q__

t__th_b_r_s_h

s_m_l_

t__th

t__th_p_s_t_

X_r_y

Keys: mouthguard, nutrition, plaque, toothbrush, smile, tooth, toothpaste, x-ray
Answers: brush, cavity, chew, clean, decay, dentist, floss, fluoride, food, gums, jaws, mouth, nutrition, plaque, toothbrush, smile, tooth, toothpaste.
Module 1: “Protect Your Prized Possession!”
20 - 40 minutes

Key Message
Healthy teeth and mouth are important parts of a healthy body. Taking proper care of teeth now helps them last a lifetime.

Student goals
Upon completing this module students should be aware of the three basic steps to good oral health:
- Brush with fluoride toothpaste twice each day, and floss once each day.
- Eat nutritious foods and limit snacks.
- Visit your dentist regularly.

Module Topics (with discussion points and questions)

1. Value. Discuss what makes something valuable. [Write down all answers that apply to teeth: can’t be replaced, good quality, lasts a long time, looks nice.] What about your teeth? Are they valuable? [Get opinions.] What do your teeth help you do?

   Our teeth help us talk, eat and give us beautiful smiles!

2. Primary and permanent teeth. How many sets of teeth do people get in a lifetime? [Two.] What were your first teeth called? [Baby or primary teeth.] When you were little you got 20 baby teeth. Why did they fall out? [As children grow they need bigger, stronger teeth.] That’s right, as you get older you need bigger, stronger teeth. By the time people are about 18 they have all 32 adult, or permanent teeth. (Show Permanent Tooth Development.) How long do permanent teeth last? [Your whole lifetime — more than 60 years with proper care.] If you lose a permanent tooth, will another one grow in? [No.]

   We lose our 20 baby teeth and grow adult teeth because we need bigger, stronger teeth to last the rest of our lives. People get 32 permanent teeth, which can last a lifetime with proper care.
ACTIVITY #1: **Challenge Question:** Are teeth a good quality product? (Give the calculator to a volunteer.) Here’s the question: If you have your adult teeth for 60 years, and you eat three meals a day, how many times in your life will you use your teeth to chew food? [60 years x 365 days a year x 3 times a day = 65,700.] 65,700 chewing workouts — and that’s if you don’t eat snacks between meals! Now, just for fun, let’s say that it takes ten minutes to eat a meal, and that you chew your food fifty times a minute. Can you figure out how many times your teeth would chew during those 65,700 workouts? [10 minutes x 50 chews/minute x 65,700 meals = 32,850,000 chews.] 32,850,000 chews! That’s almost 33 million times for each tooth! Do you think your teeth are a good quality product? You bet!

Permanent teeth can last more than 60 years!

3. **What happens if we don’t take care of our teeth?** So taking care of your teeth sounds like a smart idea. What happens to your teeth if you don’t take care of them? [Wait until someone mentions “cavities.”]

4. **What a cavity is.** Let’s talk about cavities and what causes them. What is a cavity? [A little hole in your tooth.] Right. A cavity is another name for tooth decay. What happens when something decays? [Gets rotten, falls apart, loses strength.] It’s no different with your teeth. When your teeth decay, they lose their strength. The decay can also spread throughout your tooth.

A cavity is a small hole in a tooth, also known as tooth decay.

5. **What plaque is.** Does anyone know what causes cavities? [You may get a variety of answers, but they may not include plaque.] Those are all interesting answers, but there is one thing that plays a big part in causing decay, or cavities, in your teeth. It is called “plaque.” [Write “plaque” on chalkboard.] Sound familiar? If you don’t brush your teeth before you go to bed at night, how does your mouth feel when you wake up in the morning? [Tastes bad, smells bad, teeth feel sticky.] That is because plaque has been forming in your mouth all night. Plaque is a sticky, clear film that is forming on your teeth all the time.

Plaque is a sticky, clear film that is constantly forming on your teeth.

6. **How plaque contributes to decay.** Plaque is bad for your teeth because it contains germs. When you eat or drink sugary or starchy foods, the sugars and plaque mix together to make an acid. The acids in your mouth attack your tooth enamel — the hard outer layer of each tooth — and can cause decay. Each acid attack can last 20 minutes, making cavities bigger and bigger. Let’s do a demonstration to help us understand how acid works on teeth.
ACTIVITY #2: Acid Attack. Place a Tums® tablet in each of two paper cups. Cover one tablet with vinegar; cover the other with water. Wait five minutes and empty the liquid out of the cups. What has happened to the tablets? The one in the vinegar has dissolved much faster than the one in plain water because vinegar is an acid. Both the Tums® tablet and a tooth contain calcium, and calcium dissolves more readily in acid than in water. [You may need to divide the class into 2 groups so that all the children can see. If possible, recruit another adult to assist with the demonstrations.]

The sugars and germs in plaque mix together to make acid. The acids in your mouth attack your teeth and can make cavities. Repeated acid attacks make cavities grow bigger.

7. Repairing cavities. What happens when someone gets a cavity in their tooth? Does it heal itself? [No. You have to go to the dentist to get it fixed.] That's right. Only your dentist can fix a cavity, by removing the decay and putting a special filling material in the hole.

Cavities cannot go away by themselves. They must be repaired by a dentist.

8. Keeping teeth and gums healthy. So what can we do to get rid of the acid? How can you fight plaque and acid and keep those valuable permanent teeth healthy? [List answers which may include brushing, flossing, visiting the dentist, good food and beverage choices.] Let's talk about some of these.

9. Proper brushing. Let's list all the good things that happen when we brush our teeth. [Brushing cleans food and plaque off your teeth, fights acid, makes your breath smell good, makes your mouth taste good.] Good answers. How often should you brush your teeth? [Twice a day.] There is a very important ingredient in most toothpastes that helps your teeth. Does anyone know what it is? [Fluoride.] Who knows what fluoride does? [Fluoride prevents cavities by strengthening and protecting the tooth enamel from acid.]

Brush twice a day with a fluoride toothpaste. Fluoride toothpaste helps prevent cavities by strengthening and protecting tooth enamel.

Move the brush back and forth gently in short strokes. Brush the top, front, and back sides of each tooth. You should also brush your tongue — very gently! Really! Your tongue has lots of germs on it that can cause your breath to smell bad.
ACTIVITY #3: Here is a picture of one good way to brush your teeth. It says...
(Show How to Brush and read instructions. Ask for questions and comments.)

Move the brush back and forth gently in short strokes.  
Brush the top, front and back sides of each tooth.  
Brush your tongue gently, too.

10. Toothbrushes. What kind of toothbrush is best for your teeth? Should it be large or small? [Get several answers.] You’re right! You should use a toothbrush is easy to hold and helps you reach all your teeth.

Use a toothbrush that is easy to hold and helps you reach all your teeth.

ACTIVITY #4: (Show Old and New Toothbrushes and discuss when to get a new toothbrush.) Here are two toothbrushes. How can you tell if you need a new toothbrush? [If the bristles are bent or broken.] Yes, you should get a new toothbrush when the bristles are bent and worn out. A worn out toothbrush can’t clean the plaque off your teeth very well.

11. Flossing. Who remembers what dental floss is? [A special kind of string for cleaning between your teeth.] How many of you floss? How many of you floss once a day? Cleaning between your teeth with floss is just as important as brushing. Do you know why? [Flossing cleans between the teeth, where your toothbrush can’t reach.] Flossing helps keep your teeth AND gums healthy! Flossing is not as easy to do as brushing, so you might have to ask your dentist, parents or another adult to show you how to do it properly. You should floss your teeth very gently, once a day.

Floss your teeth gently, once a day.

ACTIVITY #5: Show floss and explain the technique used in How to Floss.

12. Good nutrition. How does what we eat or drink affect our teeth? [Get a few comments.] What we eat can affect how much acid is made by the plaque in our mouths. Who remembers the food groups? [Make list on board.] Eating a mix of foods from these groups for breakfast, lunch and dinner is the best way to keep your teeth and whole body in good shape. (Visit www.mypyramid.gov for more information.) Let’s see how good you are at making up some healthy meals.
ACTIVITY #6 (if time allows): Divide the class into teams of four students. See which group can make a menu of three balanced meals first. Discuss the choices, and how nutritious foods benefit your teeth as well as your total health.

Eating a nutritious mix of foods is the best way to keep your teeth and body healthy.

Good job! But what about snacks, sweets and soda pop? [Get opinions.] Eating sweets all day or drinking lots of soda pop is not good for our bodies, and it can cause cavities, too. Who remembers what happens in our mouths after we eat? Yes, plaque and sugar mix to form acid. Then the acid attacks our teeth. The more often we eat snacks, the more acid attacks we have. But that doesn't mean that all snacks are bad for you. Sometimes growing children and teens need to eat between meals. If you are hungry and need a snack, choose nutritious foods like fruit, low-fat cheese, low-fat yogurt or raw vegetables. If you are thirsty, have a glass of water or low-fat milk. Save the sweets to eat and drink with your meals. A full meal produces lots of saliva in your mouth that helps wash away the acids from your teeth.

If you have sweets, eat or drink them with your meals. If you need a snack, choose nutritious foods.

What about chewing gum? [Get opinions.] Chewing gum for about 20 minutes immediately after a meal or snack is okay as long as the gum is sugarless. In fact, sugar-free gum makes your mouth produce more saliva that can help rinse the acid off your teeth. When you are finished chewing, be sure to throw it away in a trash can.

Chewing sugarless gum increases saliva and helps wash out food and acid.

13. Dental visits. So far we have talked about three important ways you can care for your teeth — brushing, flossing and eating nutritious foods. There is one more very important thing we should all do to keep our teeth and gums healthy. Who can tell me what it is? Yes! Visit your dentist regularly. What does your dentist do? [Examines your teeth and mouth to see if they are healthy. Tells you how to take good care of your teeth. Fixes cavities and repairs teeth.] What else happens when you go to the dentist? [Get your teeth cleaned, have X-rays to see the insides of teeth to check for cavities and other problems, may get fluoride treatments.] Your dentist will tell you when your next visit should be.

Visit your dentist regularly.

Let's review what we know:

Summary: Kids in 4th, 5th and 6th grades can do a lot to help keep their teeth and gums in great shape! Brush twice a day with fluoride toothpaste, floss once a day, eat nutritious foods and limit snacks and visit your dentist regularly.

Used with permission from the ADA
Permanent Tooth Development

**Upper Teeth**
- Central incisor: 7-8 yrs.
- Lateral incisor: 8-9 yrs.
- Canine (cusp): 11-12 yrs.
- First premolar (first bicuspid): 10-11 yrs.
- Second premolar (second bicuspid): 10-12 yrs.
- First molar: 6-7 yrs.
- Second molar: 12-13 yrs.
- Third molar (wisdom tooth): 17-21 yrs.

**Lower Teeth**
- Third molar (wisdom tooth): 17-21 yrs.
- Second molar: 11-13 yrs.
- First molar: 6-7 yrs.
- Second premolar (second bicuspid): 11-12 yrs.
- First premolar (first bicuspid): 10-12 yrs.
- Canine (cusp): 9-10 yrs.
- Lateral incisor: 7-8 yrs.
- Central incisor: 6-7 yrs.
How to Brush

• Place the toothbrush at a 45-degree angle to the gums.

• Move the brush back and forth gently in short strokes.

• Brush the outer surfaces, the inside surfaces and the chewing surfaces of all teeth.

• To clean the inside surface of the front teeth, tilt the brush vertically and make several up-and-down strokes.

• Brush your tongue to remove bacteria and keep your breath fresh.
Old & New Toothbrushes
How to Floss

• Use about 18 inches of floss wound around one of your middle fingers, with the rest wound around the opposite middle finger.

• Hold the floss tightly between the thumbs and forefingers and gently insert it between the teeth.

• Curve the floss into a “C” shape against the side of the tooth.

• Rub the floss gently up and down, keeping it pressed against the tooth. Don't jerk or snap the floss.

• Floss all your teeth. Don’t forget to floss behind your back teeth.
Module 2: “Extra Protection for Terrific Teeth”
approximate time: 10 minutes

Key Message
In addition to good oral hygiene and regular dental visits, sealants, mouthguards and good health habits can help teeth last a lifetime.

Student goals
Upon completing this module students should be aware of additional ways that teeth can be protected and kept healthy:

- What dental sealants are, and how they protect teeth from cavities.
- Why wearing mouthguards during active sports is important.
- Recognizing and eliminating behaviors that can harm their teeth.

Module Topics (with discussion points and questions)

1. Dental sealants. In addition to keeping your teeth clean, eating nutritious foods and visiting your dentist regularly, there are several other ways you can help your teeth last a lifetime. Does anyone know what dental sealants are? [Some children may have already had sealants applied to their teeth and may be able to explain the process to the class.] After your permanent molars have come in — the large adult teeth toward the back of your mouth — your dentist can coat them with a special dental plastic that seals out decay. Applying sealants is quick, easy and painless. Sealants can last for several years. How many of you have had sealants applied to your permanent teeth? Sealants are additional protection from decay that many of your parents didn’t have. When your parents were children, getting cavities was much more common than it is today. This doesn’t mean that you can stop caring for your teeth. You still need to brush and floss every day! Sealants are added protection.

ACTIVITY #7: Sealant Application. Here is a picture of a dental sealant being applied to a tooth. [If time permits, discuss students’ experiences with sealants.]

Dental sealants are a special plastic coating that protect teeth from decay.
ACTIVITY #8: Let’s do another experiment, this time to see if a plastic coating can protect our pretend tooth from the acid in vinegar. (Repeat Tums® acid test, this time to show the effectiveness of sealants. Wrap one Tums® in plastic wrap and seal with transparent tape, leaving the other unwrapped. Place each in the bottom of a paper cup. Cover both with vinegar. Wait five minutes and pour off the liquid. Unwrap the plastic from the Tums® tablet. The plastic has protected the “tooth” from the acid.) [You may need to divide your class into 2 groups so that all the children can see. If possible, recruit another adult to assist with the demonstrations.]

2. Mouthguards. There is something else you can do to protect your teeth, but this is used to help protect your teeth from getting broken or knocked out. Does anyone know what I’m thinking of? I’ll give you a hint. You use it for active sports. [Mouthguard.] That’s right! A mouthguard. How many of you have ever worn a mouthguard? A mouthguard is a piece of soft, molded plastic that covers your upper teeth. Your dentist can make one that fits your teeth exactly, or you can buy an unshaped mouthguard at the store that can be softened in boiling water and then shaped to fit over your teeth.

ACTIVITY #9: Mouthguard. Here is a picture of a mouthguard. Can someone explain to the class how it fits on the teeth?

Why is it so important to use a mouthguard? [Because if you lose your permanent teeth, new ones will not grow in to replace them.] Do you know anyone who has had teeth knocked out during sports? Will those teeth ever grow back? Wearing a mouthguard is smart even if you don’t really want to wear it.

Let’s list all the sports and activities that we can think of where your teeth and mouth might be injured. (Remember to include non-team sports such as skateboarding, gymnastics, and rollerblading.)

Mouthguards protect teeth from injury and should be used during all active sports.

Your dentist can make a custom mouthguard, or a self-fitted mouthguard can be purchased at a store.

3. Behaviors that can hurt teeth. Is there anything else you can do to protect those priceless treasures in your mouth? Sometimes NOT doing certain things is just as important as the positive things you do. Avoiding bad habits and unhealthy activities is important too. Can anyone name something you might do that would injure your teeth or the health of your mouth? [Write suggestions on chalkboard.]
4. **Chewing on hard objects.** What about chewing on hard objects? Chewing on ice cubes, pencils and pens, or even hard candy can chip or crack your teeth. Even though your teeth are made to last a lifetime, they are made for chewing food only!

**Don’t chew on hard objects like pencils, ice cubes or hard candy.**

5. **Tobacco.** There is another bad habit that is very dangerous, not only for your teeth, but for your mouth and entire body: using tobacco products. Tobacco is bad for your total health. All tobacco — not just cigarettes and cigars. Smokeless tobacco, also called chew, can cause mouth, tongue and lip cancer, and is sometimes more addictive than cigarettes. Tobacco products also stain your teeth and cause gum disease and tooth loss. AND — tobacco products cost a lot of money! Bottom line: There is nothing good to say about tobacco products. Never starting is your best defense against all the health problems related to tobacco.

**Tobacco products can cause gum disease, tooth loss and cancer. BE SMART; DON’T START! AND SAVE MONEY, TOO!**

We have learned a lot about our teeth today and how to take good care of them.
1. Taking good care of our teeth is something that each of us can do.
2. Your permanent teeth are meant to last a lifetime.
3. Special activities and conditions require extra “tooth attention."

**Summary:** *Kids, parents and their dentist can work together to provide extra protection for precious teeth.*

**ACTIVITY #10:** Have students work individually or in pairs to complete the activity sheet *Teeth to Treasure! Word Search* or *Teeth to Treasure! Word Search Challenge* (based on students’ ability levels or time allowed). [You may wish to have copies of *Permanent Tooth Development* and *Tooth Anatomy* available as a reference.]
Mouthguard
Teeth to Treasure!
Word Search

See how many words you can find in 20 minutes!
Words go across, up, down, and diagonal.

CAVITY
DAILY
DENTIST
ENAMEL
FLOSS
FLUORIDE
FRUIT
GRAINS
GUMS
MEAT
MILK
MOUTHGUARD
PLAQUE
SEALANT
TOBACCO
TONGUE
TOOTHPASTE
TOOTHBRUSH
VEGETABLES
Teeth to Treasure!
Word Search Challenge

See how many words you can find in 20 minutes!
Words go across, up, down, and diagonal.

CAVITY  FRUIT  MILK  ROOT  TOOTHBRUSH
DAILY  GRAINS  MOUTHGUARD  SEALANT  TOOTHPASTE
DENTIST  GUMS  ORAL  SUGAR  TOOTHPASTE
ENAMEL  JAW  PLAQUE  TOBACCO  VEGETABLES
FLOSS  LIPS  PREVENTION  TONGUE  XRAY
FLUORIDE  MEAT  PRIMARY  TOOTH  XRAY
Permanent Tooth Development

**Upper Teeth**
- Central incisor: 7-8 yrs.
- Lateral incisor: 8-9 yrs.
- Canine (cuspid): 11-12 yrs.
- First premolar (first bicuspid): 10-11 yrs.
- Second premolar (second bicuspid): 10-12 yrs.
- First molar: 6-7 yrs.
- Second molar: 12-13 yrs.
- Third molar (wisdom tooth): 17-21 yrs.

**Lower Teeth**
- Third molar (wisdom tooth): 17-21 yrs.
- Second molar: 11-13 yrs.
- First molar: 6-7 yrs.
- Second premolar (second bicuspid): 11-12 yrs.
- First premolar (first bicuspid): 10-12 yrs.
- Canine (cuspid): 9-10 yrs.
- Lateral incisor: 7-8 yrs.
- Central incisor: 6-7 yrs.
Tooth Anatomy

- Enamel
- Crown
- Gingiva (gums)
- Pulp chamber
- Neck
- Dentin
- Alveolar bone (jawbone)
- Root canal
- Cementum
- Root
- Periodontal ligament
- Nerves and blood vessels
Module 1: “Be Smart about Your Smile!”
15 -30 minutes

Key Message
Taking proper care of your teeth enhances your total health and gives you a more attractive appearance.

Student goals
Upon completing this module students should be aware that good oral health habits:
- Help keep their whole body healthy and fit.
- Can help them do their best at school and in sports (because they will feel better, both physically and psychologically).
- Have cosmetic benefits, including a nicer looking smile, fresh breath, and social confidence.

Module Topics (with discussion points and questions)

1. *Personal appearance.* Let’s make a list of things that help a person be more attractive. I don’t mean good looking or popular; I’m looking for ideas about what makes people of any age attractive. [List on chalkboard: Personality attributes like friendliness, intelligence, confidence; Physical attributes like their smile, cleanliness, being physically fit, having good health.]

2. *The benefits of a nice smile.* Since we are going to be talking about teeth and good oral health in a few minutes, let’s talk a little more about having an attractive smile. What does it take to get and keep a nice smile? [Keep teeth clean by brushing and flossing, visit your dentist, eat nutritious foods, don’t smoke.] Yes, all those things affect your smile, your teeth, your health and your appearance.

   Good oral health habits play a big part in having a nice smile, speaking well, being able to eat properly and having confidence.

3. *What happens if teeth are not cared for?* So taking care of your teeth sounds like a smart idea. What happens to your teeth if you don’t take care of them? [Bad breath, stains, cavities, swollen gums, maybe tooth loss.]

4. *What a cavity is.* None of those things sound very appealing. Let’s talk about cavities and what causes them. What is a cavity? [A little hole in your tooth.] Right. A cavity is another name for tooth decay. What happens when something decays? [Gets rotten, falls apart, loses strength.] It’s no different with your teeth. When your teeth decay, they lose their strength. The decay can spread throughout your tooth.
A cavity is a small hole in a tooth, also known as tooth decay.

5. **What plaque is.** Does anyone remember what causes cavities? [You may get a variety of answers, but they may not include plaque.] Those are all interesting answers, but there is one thing that plays a big part in causing decay, or cavities, in your teeth. It is called “plaque.” Sound familiar? If you don’t brush your teeth before going to bed at night, how does your mouth feel when you wake up in the morning? [Tastes bad, smells bad, teeth feel sticky.] That is because plaque has been forming in your mouth all night. Plaque is a sticky, clear film that is forming on your teeth 24 hours a day.

**Plaque is a sticky, clear film that is constantly forming on your teeth.**

6. **How plaque contributes to decay.** When you eat or drink foods containing sugars and starches, the bacteria (germs) in plaque produce acids that attack tooth enamel. The stickiness of the plaque keeps the harmful acids against the teeth. After many such attacks, the tooth enamel — the hard outer layer of each tooth — breaks down and a cavity forms. Each acid attack can last as long as 20 minutes, making cavities bigger and bigger. So, do any of you think you have plaque on your teeth right now?

7. **Plaque and gum disease.** If the plaque is not removed effectively with daily brushing and cleaning between teeth with floss, it eventually hardens into calculus or tartar. Tartar must be removed, because it makes your teeth more difficult to clean. If tartar is not removed, it can lead to gingivitis, an early form of gum disease in which your gums become irritated and can bleed easily. [Gingiva = gums; -itis = inflammation] That’s why it is important to brush your teeth twice a day, floss daily and have your teeth professionally cleaned at the dental office.

The sugars in food and germs in plaque mix together to make acid. The acids in your mouth attack your teeth and can make cavities. Repeated acid attacks make cavities grow bigger.

Twice-daily brushing and once-daily flossing help remove bits of food and plaque from the mouth and are *essential* in preventing both tooth decay and gum disease.

7. **Repairing cavities.** What happens when someone gets a cavity in their tooth? Does it heal itself? [No. You have to go to the dentist to get it repaired.] That’s right. Only your dentist can repair a cavity, by removing the decay and putting a special filling material in the hole.
Cavities cannot go away by themselves. They must be treated by a dentist.

8. *Three ways to keep teeth their best.* Let’s talk about the three main ways we can keep those “pearly whites” in smiling condition: proper brushing and flossing, eating nutritious foods, and regular dental visits.

9. *Proper brushing.* Let’s start with brushing, and list all the good things that happen when we brush our teeth. [Brushing cleans food and plaque off teeth, fights acid, makes your breath smell good, makes your mouth taste good.] Good answers. How often should you brush your teeth? [Twice a day.] There is an important ingredient in most toothpaste that helps your teeth. Does anyone know what it is? [Fluoride.] What does fluoride do? [Fluoride prevents cavities by strengthening and protecting the tooth enamel from acid.]

**Brush twice a day with a fluoride toothpaste.**
**Fluoride toothpaste helps prevent cavities by protecting tooth enamel.**

Move the brush back and forth gently in short strokes. Brush the top, front, and back sides of each tooth. If you are wearing braces, you should ask your general dentist or orthodontist about the best way to brush and keep your teeth clean.

You should also *gently* brush your tongue. Really! Your tongue has lots of germs on it that can cause your breath to smell bad. And by the way, toothbrushes don’t last forever. If your toothbrush looks like this (hold up *Old and New Toothbrushes*), with bent or broken bristles, it’s time to toss it and get a new one! You should use a toothbrush that is comfortable to hold and easily reaches all tooth surfaces.

**ACTIVITY #1:** Here is a picture of one way to brush your teeth. It says...
(Show *How to Brush* and read instructions. Ask for questions and comments.)

Move the brush back and forth gently in short strokes.
Brush the top, front and back sides of each tooth.
Brush your tongue gently, too.

Use a toothbrush that easily reaches all tooth surfaces and is comfortable to hold.

10. *Flossing.* How many of you floss your teeth each day? Flossing cleans between your teeth, which is just as important as brushing them. There are lots of types of floss you can choose from — waxed, unwaxed, flavored, string or flat tape. Flossing is not as easy to do as brushing, so if you don’t remember how, ask your dentist, then practice.
You should floss once a day. Why is flossing important? [Helps remove bits of food and plaque from between teeth, where your toothbrush can't reach. Helps keep your gums healthy.] Your permanent teeth are much closer together than your baby teeth were, and flossing those choppers is essential for healthy teeth and gums — and fresh breath, too! But floss gently. It doesn't take a lot of muscle to remove the plaque and debris from between your teeth — just determination.

Floss your teeth gently, once a day.

**ACTIVITY #2:** Show floss and explain the technique used in *How to Floss.*

11. *Good nutrition.* How does what we eat and drink affect our teeth? [Get a few comments.] What we eat and drink, and how often, affect how much acid is made by the plaque in our mouths.

**What we eat and drink, and how often, affect how much acid is produced in our mouths.**

Who remembers the food groups? [List on board.] Eating a mix of foods from these groups for breakfast, lunch and dinner is the best way to keep your teeth and whole body in good shape. You know how important it is to eat right when you are in sports or dance. Well, your teeth are just as affected by what you put in your mouth. Did you know that Olympic athletes have their own dentist? That's because athletes cannot reach peak performance if their mouths are sore or if their teeth ache. Eating a nutritious mix of foods also helps you stay at your proper weight, helps keep your skin clear and makes your hair shiny! (Visit [www.mypyramid.gov](http://www.mypyramid.gov) for more information.) So let's see how good you are at making up some healthy meals.

**ACTIVITY #3:** Divide the class into teams of four students. See which can be the first group to make up a menu of three balanced meals and two healthy snacks. Discuss the choices, and how nutritious foods benefit your teeth as well as your total health.

**Eating a nutritious mix of foods from the food groups is the best way to keep your teeth and body healthy.**

Those are very creative meal ideas! But what about sweets? Do you have to give up ALL sweets to have a healthy body and teeth? [Get opinions.] Munching on snacks all day and drinking lots of soda pop is not good for your body. It can cause an unhealthy
weight gain and cavities, too! Who remembers what happens in our mouths after we eat? Yes, plaque and sugar mix to form acid. Then the acid attacks our teeth. The more often we eat snacks, the more acid attacks we have. Don’t eat too many sweets or drink a lot of soda pop. But if you have sweets, eat or drink them with your meals, because your saliva helps wash the acid off your teeth. If you need a snack between meals, choose nutritious foods like fruit, low-fat cheese, low-fat yogurt, or raw vegetables. If you are thirsty, have a glass of water or low-fat milk.

If you want sweets, eat or drink them with your meals.
If you snack, eat nutritious foods.

What about chewing gum? [Get opinions.] Chewing gum for about 20 minutes immediately after a meal or snack is okay as long as the gum is sugarless. In fact, sugar-free gum makes your mouth produce more saliva, which helps rinse the acid off your teeth to prevent tooth decay.

Chewing sugarless gum increases saliva and helps wash out food and acid.

12. Dental visits. So far we have talked about three important ways you can care for your teeth — brushing, flossing and eating nutritious foods. There is one more very important thing we should all do to keep our teeth healthy — visit our dentist regularly. What does your dentist do? Let’s list some of the things that can happen during a routine dental visit. [Examines your teeth, gums and the rest of your mouth to see if they are healthy; tells you how to take good care of your teeth; fixes cavities and repairs teeth; checks your mouth for sores and signs of cancer; sometimes takes X-rays to see the insides of teeth and jawbone; gives you a fluoride treatment.]

What else? [You have your teeth professionally cleaned.] Why is that important? [Even when you brush well, some plaque stays on your teeth and, over time, hardens into tartar. Tartar can only be removed by a professional cleaning.] Who remembers what we said earlier about why tartar must be removed from teeth? [Tartar must be removed because it makes your teeth more difficult to clean. If tartar is not removed, it can lead to gingivitis, an early form of gum disease in which your gums become irritated and can bleed easily.]

Ask your dentist when your next visit should be!

Visit your dentist regularly.
A routine dental visit includes an examination of your teeth and mouth, professional cleaning, and may include X-rays, repair of damaged teeth and a fluoride treatment.

Summary: Good oral health care provides many benefits that go beyond cavity prevention.
- It helps keep your whole body healthy and fit.
- It can help you do your best at school and in sports, because you will feel better, both physically and mentally.
- It has cosmetic benefits, including a nicer looking smile, fresh breath, and social confidence.
How to Brush

- Place the toothbrush at a 45-degree angle to the gums.

- Move the brush back and forth gently in short strokes.

- Brush the outer surfaces, the inside surfaces and the chewing surfaces of all teeth.

- To clean the inside surface of the front teeth, tilt the brush vertically and make several up-and-down strokes.

- Brush your tongue to remove bacteria and keep your breath fresh.
How to Floss

• Use about 18 inches of floss wound around one of your middle fingers, with the rest wound around the opposite middle finger.

• Hold the floss tightly between the thumbs and forefingers and gently insert it between the teeth.

• Curve the floss into a “C” shape against the side of the tooth.

• Rub the floss gently up and down, keeping it pressed against the tooth. Don’t jerk or snap the floss.

• Floss all your teeth. Don’t forget to floss behind your back teeth.
Module 2: “Going the Extra Mile for Tooth Protection” approximate time: 15 minutes

**Key Message**
In addition to daily dental health care, there are many ways that teens can protect their smiles.

**Student goals**
Upon completing this module students should be aware of additional ways that teeth can be protected and kept healthy:
- Recognizing and eliminating behaviors that can harm teeth, such as mouth piercing and tobacco use.
- Wearing mouthguards during active sports is important to protect teeth, mouth and face.

**Module Topics (with discussion points and questions)**

1. *Popular behaviors and bad habits that can damage teeth and health.* One of the toughest parts about being a teen is that you have to make choices that can affect your health, your appearance and your future. Some are just little things, like how you wear your hair, but some are decisions that can have a lasting effect on your life. We are going to talk about a few that are directly related to the health of your teeth and mouth.

2. *Trends and peer pressure.* Why is it so hard sometimes to make smart choices?
   [Comments may include: developing bad habits; the difficulty of going against trends or peer pressure; not knowing what the smart choice is; sometimes bad choices are more fun than good choices.] What are some choices that you may have to make — either now or as you get older — that can affect your teeth and mouth? [mouth piercing/mouth jewelry; smoking; chewing tobacco; eating too much junk food and drinking too much soda pop; not visiting the dentist; not using a mouthguard]

3. *Bad habits.* Let’s talk first about getting rid of a bad habit that many of us have — chewing on hard objects. Do you ever find yourself chewing on ice cubes, pencils and pens? Chewing on hard objects — even hard candy — can chip or crack your teeth. Your teeth are made to last a lifetime, but they are made for chewing food only! How can you break a bad habit like chewing on hard objects? [Put notes reminding yourself not to chew on things around your house and desk; ask friends to remind you if they see you chewing on stuff; chew more sugarless gum.] It’s hard to break bad habits, but you can do it! Recognizing that you have a bad habit is the first step.

   **Don’t chew on hard objects like pencils, ice cubes or hard candy. Ask friends and family to help you break bad habits.**
4. *Tobacco.* There is another bad habit that is very dangerous, not only for your teeth, but for your mouth and entire body: using tobacco products. ALL tobacco is bad for your health, not just cigarettes and cigars. Smokeless tobacco, also called chew, snuff, dip or spitting tobacco, has become a very serious health problem for teens and young adults today. You know that smoking cigarettes can eventually kill you. You may not know that smokeless tobacco can cause mouth, tongue and lip cancer, and can be more addictive than cigarettes. Tobacco products also stain your teeth and cause gum disease and tooth loss. That certainly won’t help your appearance any! Listen to these statistics: 1.) Approximately 28,000 people were diagnosed as having oral (mouth) cancer last year. Many of them probably thought they were safe because they used smokeless tobacco. Wrong! 2.) About 7,200 people will die from mouth cancer this year. AND – tobacco products cost a lot of money! Bottom line: There is nothing good to say about tobacco products. Never starting is your best defense against all the health problems related to tobacco.

Tobacco products are expensive and cause gum disease, tooth loss and cancer. BE SMART; DON’T START! AND SAVE MONEY, TOO!

**ACTIVITY #4:** Working in pairs, have the students write anti-tobacco-use slogans. Choose a class favorite and write it on a large piece of poster board to hang in your classroom.

5. *Mouth jewelry.* Let’s talk about mouth jewelry. You might think pierced lips and tongues are attractive, or you might not, but you probably don’t know just how dangerous these piercings can be. What do you think can happen to your teeth and mouth from piercings? [List on chalkboard: mouth sores and infections; chipped or cracked teeth; you can choke.] That’s a good start, but it gets worse! Your mouth contains millions of bacteria, and infection and pain often occur with mouth piercing. Your mouth and tongue can swell up large enough to close off your airway. Piercing can also cause nerve damage and uncontrollable bleeding. You can choke on parts that come off in your mouth, and you can crack your teeth if you bite down on the jewelry. Mouth piercing is a decision that goes way past looking fashionable — it can have a big effect on your health!

Mouth piercing can result in infection, swelling, pain, choking, uncontrolled bleeding and cracked or chipped teeth.

6. *Mouthguards.* There is a good habit you can get into that will help protect your teeth from getting broken or knocked out. Does anyone know what I’m thinking of? I’ll give you a hint. You use it for active sports. [Mouthguard.] That’s right! A mouthguard. How many of you have ever worn a mouthguard? A mouthguard is a piece of soft, molded plastic that covers your upper teeth. Your dentist can make one that fits your teeth exactly, or you can buy an unshaped mouthguard that can be softened in boiling water and then shaped to fit over your teeth.

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ACTIVITY #5: *Mouthguard*. Here is a picture of a mouthguard. Can someone explain to the class how it fits on the teeth?

Why is it so important to use a mouthguard? [Because if you lose your permanent teeth, new ones will not grow in to replace them.] Do you know anyone who has had teeth knocked out during sports? Will those teeth ever grow back? Mouthguards also help prevent injuries to your lips, face and jaw. Wearing a mouthguard is very smart even if you don’t think it’s a great fashion statement!

ACTIVITY #6: Let’s make a list of all the sports and activities that we can think of in which your teeth and mouth might be injured. (Remember to include non-team sports such as skateboarding, gymnastics and rollerblading.)

Mouthguards protect teeth from injury and should be used during all active sports.
Your dentist can make a custom mouthguard, or a self-fitted mouthguard can be purchased at a store.

Summary: In addition to the basics of good oral hygiene, smart teens avoid behaviors that can damage their health and appearance, and protect their teeth during active sports by wearing mouthguards.

ACTIVITY #7: Have students work individually or in pairs to complete the activity sheet *Watch Your Mouth! Crossword Puzzle*. [You may wish to have copies of *Permanent Tooth Development* and *Tooth Anatomy* available as a reference.]
Watch Your Mouth!
Crossword Puzzle

Across
2. A food, deep yellow inside, belonging to the vegetables group
4. A primary cause of cavities and gingivitis
8. The innermost tissue of a tooth
11. With good personal and professional care, you should keep your teeth as long as you are _____.
13. The unit you are studying is about ____ health.
14. A liquid containing calcium
15. The thin, hard covering of the root of a tooth
16. Most dentists recommend a tooth brush with soft ________.
17. A dangerous product that is bad for your total health
18. A food with a white inside, belonging to the vegetables group
20. A natural substance which can help prevent cavities
21. A member of the grains group, frequently eaten in Asian countries
22. A watery secretion that bathes teeth and promotes digestion
23. Used to remove plaque

Down
1. The most common dental disease among young people
3. Protects teeth during sports
5. The periodontal ________ holds the tooth in its bony socket.
6. The hard outer covering of a tooth
7. Coating that protects teeth from decay
9. The part of the mouth just outside the teeth
10. A good substitute for meat
11. The type of bone in which teeth are embedded
12. ________ disease can result in destruction of tissues surrounding the tooth.
18. A fuzzy-skinned member of the fruits group
19. The front teeth
20. Cleans between teeth